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ECL 114A

DEVELOPMENT OF A CIRCULAR STRIKE PLATE AT SCHLAGE LOCK COMPANY

an engineering case in four parts

 Prepared in the Design Division, Department of Mechanical Engineering, Stanford University, by Richard C. Bourne, with support from the National Science Foundation. The assistance of Mr. E. L. Schlage is gratefully acknowledged.

DEVELOPMENT OF A CIRCULAR STRIKE PLATE AT THE SCHLAGE LOCK COMPANY (A)

Introduction

In March 1963, Mr. Ernest L. Schlage, Director of Research at the Schlage Lock Company, San Francisco, California, and son of the inventor of the modern door lock, pondered the design of a new strike plate.* The new "pre-hung" door concept had opened the market for a strike more easily installed than the traditional rectangular model; the construction industry wanted a strike for which they could prepare the jamb with a single boring operation, rather than the present routing** or hand chiseling. Mr. Schlage later commented, "Our investigations showed that several of our competitors already held patents on circular strikes, but these designs did not provide sufficient allowance for door sag. We hoped to develop a superior strike which would not infringe these patents, and which might even be patentable itself."

Mr. Marron Kendrick, President of the Schlage Lock Company, added, "For years we have concentrated on development of the lock assembly, neglecting the strike as an insignificant part of the system. Our marketing group had recently reported, however, that the introduction of a bore-in strike could now spur a substantial growth in sales of Schlage residential locks. When I first reviewed some of our preliminary research work on this project, I was amazed at what improvements the engineers were making on an item so common and apparently simple that it had resisted basic change for at least a century."

* The strike plate or "strike" is located in the face of the door jamb, and receives the extended lock latchbolt to hold the door in a closed position.

** Routing is a power woodcutting operation in which a rotary bit cuts a relatively shallow bore and then moves laterally to produce a depressed plane surface of variable shape.

The Company

The Schlage* Lock Company, founded in 1920 with a working capital of $30, was, by 1925, turning out 20,000 locks a month; it now produces that many in a day and is the world's largest producer of door locks. Originating in a San Francisco loft with a total employment of four, the company today employs 1700 people in its modern manufacturing plant. Schlage limits its product line to door locks for residences and commercial buildings, related hardware such as strike and escutcheon plates, and, in limited quantities, tools for the installation of these products.

The initial growth of the company resulted from the excellence of its first product, a remarkable invention patented by Walter Schlage. Ernest Schlage, presently serving the company as Vice President and Director of Research, states, "My father revolutionized the lock industry with the introduction of the cylindrical door lock. Today, we and all our competitors manufacture locks which

* The pronunciation of "Schlage" has been Americanized to rhyme with "vague."

are, in their basic features, substantially identical to my father's designs of the 1920's." Walter Schlage, a San Francisco engineer of German birth, served as chief engineer until his death in 1946; during his life he was awarded 140 patents. His son Ernest, with engineering degrees from M.I.T. and Stanford, has obtained more than 100 patents.

While patents protecting the basic cylindrical lock have long since expired, the Schlage Lock Company has gained and maintained a position of leadership in the industry by producing locks of very high quality, and, through its Research Division, by accurately forecasting and meeting future requirements for locks.

Of the three engineering groups at Schlage, Research, with 13 employees, includes approximately one-fourth of the total number of engineers. The largest group, Production Engineering, is engaged in the design of tools, dies, and jigs for the manufacture of Schlage products; the third group, Product Design, modifies and improves existing products, and is roughly equal in size to the Research Division.

Securing The Door

Most doors are held in a closed (or "latched") position by a system comprised of a retractable latchbolt located in the door edge and a strike plate fastened to the door frame, the plate being cut with a hole to receive the latchbolt. The latchbolt is spring-loaded (hence sometimes called a "springlatch") to remain in the extended position, and is wedge-shaped at its end, to be cammed back into the door upon contacting a lip on the strike plate. The latchbolt is also retracted by turning the unlocked door knob. When security is desired, doors are equipped to *lock* as well as *latch*. In older devices, locking was accomplished by turning either a key or thumbturn in the chassis of the lock, thus moving a heavy bolt into a second hole in the strike plate. Unlike the springlatch, this bolt cannot be forced into the retracted position by wedging a blade or strong card between the door edge and frame; for this reason it is called a "deadbolt". For conditions of maximum security, additional deadbolt units may be installed auxiliary to the springlatch assembly.

Before introduction of the Schlage cylindrical lock, most door locks were of the mortise type (see Exhibit A-1), so called because a cavity for the device had to be chiseled, or "mortised", in the door. These locks were handfitted and expensive to produce. The hammer and chisel installation process produced alignment problems, took too long, and sometimes seriously weakened the door.

The basic breakthrough made by Walter Schlage was the introduction of a door lock composed of interlocking chassis and latch units, both cylindrical in shape. This "cylindrical door lock"* is installed simply by boring two intersecting holes in the door, one from the face (usually 2 1/8" in diameter) and one from the edge (7/8" diameter). The latch unit is inserted and secured from the edge; the lock chassis and knob spindle portion is then inserted from the face, and interlocks with the latch assembly. Fastening the mounting plate, the decorative escutcheon and then the second knob on its spindle secures the door lock in place.

* Not to be confused with the "pin-tumbler cylinder," into which the key is inserted, which is also used on almost all of today's door locks, and was invented by Linus Yale, Jr. in 1865.

A further innovation by Walter Schlage was the provision for door locking with a single latchbolt. The Schlage "deadlatch" (Exhibit A-2) combines springlatch and deadbolt characteristics in one compact assembly, which fits in the same bored hole size as the plain springlatch unit. A small spring-loaded plunger is held back by the strike plate, whose opening is shaped to receive the bolt but not the plunger. An internal mechanism locks the bolt in the extended position when the plunger is thus restrained, so that, as with a deadbolt, the door cannot be unlatched by sliding a blade between door and frame.

An added impetus to the great success of the basic Schlage lock has been its "button-locking" feature, now found on almost all door locks. This clever design ended the need for an interior key, and enables a room's occupant to tell at a glance whether the door is locked. The interior knob was always free to open the door even when the exterior knob was locked. This panic-proof feature allowed immediate egress at all times.

The installation of the cylindrical lock in just two holes left no place for locating the key cylinder except inside the exterior knob. This location proved to be very convenient for the user and greatly simplified the design of the mechanism.

Despite the continued use of the basic Schlage lock, the industry retains a dynamic outlook. There is a constant effort by lock companies and independent inventors not only to improve the design of the cylindrical lock but to invent a new, lower cost, superior lock so as to revolutionize the lock industry as did Walter Schlage half a century ago.

Strike Plates

The mortise-type lock, with its separate springlatch and deadbolt, required a rather large strike plate with two receiving holes. The introduction of Schlage's deadlatch, of course, meant that only one hole was required, but most strikes are still rectangular in shape (although smaller) and are usually mortised-in by the carpenter to fit flush with the surface of the door jamb. Thus, the installer is required to chisel out one deep recess for the latchbolt, and a second very shallow and accurately cut recess for the strike plate itself. For better appearance, many strikes are equipped with a "strike box" so that raw wood cannot be seen through the latch receiving hole. Exhibit A-3 shows various Schlage strikes.

The primary functions of the strike plate are to cam the latchbolt into the retracted position, and to provide a hole to receive the latchbolt. The strike must be strong and well-anchored to withstand the high force which may develop when the door slams shut and rebounds off the doorstop; this force is the largest to which the latchbolt and strike plate are normally subjected, and is received, on the strike plate, entirely by the straight front edge of the latch receiving hole.

Secondary functions of the strike plate are to provide compensation for misalignments between latchbolt and receiving hole; such misalignments may result either from inaccurate installation or from shifts of door and frame with time.

A vertical margin is provided in the receiving hole of most strike plates to allow for both door sag, which results from the entire weight of the door being carried at

the hinged edge, and frame sag, which often occurs as a building settles. Standard rectangular strikes are designed with up to one half inch ($\pm$ 1/4) sag allowance.

Lateral adjustability is also desirable, for if the strike is located too near the doorstop strip, the latchbolt cannot enter the receiving hole; and if the strike is located too far from the stop, the door will rattle when latched. With the conventional Tee-shaped strike, however, lateral adjustment can be accomplished only by removing the strike, extending the mortise in the direction of the desired strike movement, refastening the strike, and using putty or plastic wood to fill the newly exposed gap.

Exhibit A-4 shows a door and jamb assembly in a section view through the latchbolt and strike plate. Door thicknesses vary from 1 3/8" to 1 3/4" for standard residential doors; the latchbolt is always centered (within normal installation tolerances) in the door. The flat face of the latchbolt is about 1/4" from the bolt centerline; the strike plate is located such that when closed, the door face is flush with the jamb edge.

The Need For A New Strike

In early 1963, Schlage engineers began investigating the possibility of developing a radically new, "bore-in" strike. Salesmen and distributors noted that more and more housing developments were using "pre-hung" doors, already hinged in the frame when delivered to the construction site. With this system, boring for the latch hardware is done at the mill; usually the latch unit and strike plate are installed there as well, to hold the door closed during transport. The knob-chassis unit is installed on the job, since prior assembly would make stacking of the pre-hung doors more difficult, and could cause marring of the door surfaces. For pre-hung doors, the latch receiving hole in the jamb is usually machine bored with a bit, but a router must be used to mortise a shallow cavity for the rectangular strike plate. In terms of both time and equipment required, the routing process is more expensive than a boring operation.

One simple way to provide less expensive strike installation would be to surface-mount the strike; that is, manufacture the strike of thin metal to be fastened to the surface of the jamb (not mortised-in). The latchbolt receiving hole could then be circular and no chiseling or routing would be required for the strike plate itself. Mr. Schlage noted that, "Not long ago, a new strike aimed at the pre-hung door industry was brought out by a competitor of ours. It required the boring of a single hole, and was not mortised in flush, but rested on the surface. We experimented with this idea too, but decided that it was not really a satisfactory solution. Surface-mounted strikes have been tried by us before, and they have never been well-accepted." Drawbacks to surface mounting are poor appearance, possible interference in cases where very little clearance exists between frame and door, and, perhaps most important, low strength. The metal must necessarily be thin, and the forces exerted on the strike have to be carried to the frame entirely by the fastening screws.

In January 1963, Mr. Schlage had begun sketching possible designs for a new bore-in strike. Among these were the surface-mount explorations previously referred to. Mr. Schlage had first considered a trapezoidal strike with integral

strike box, as shown in Exhibit A-5a. With the strike lip merging into the body of the strike, this design would have a very clean appearance, and the strike box would strengthen the system; the front edge of the strike box would contact the wood and thus carry some of the load to the frame. Mr. Schlage considered fastening the strike through the bottom of the box; this would permit a strike of reduced dimension, since the rim would no longer need to be wide enough to include fastening screws. However, most residential jambs are made from 1" stock (which, after planing, is about 3/4" thick). Since strikes were usually installed at the mill, it was not permissible for any part of the installed strike to extend beyond the back of the jamb (this would interfere with jamb installation at the job site). This problem necessitated either very short screws (through the strike box bottom) or a new fastening scheme. Shorter screws would have very few threads engaged in the wood, so Mr. Schlage began sketching other fastening possibilities. Some of these are depicted in the pages from his daily notes included as Exhibit A-6.

Possible Patent Conflicts

After rejecting the surface-mount concept for their new bore-in strike, Schlage engineers began the design of a flush-mounted circular strike. A prototype of one of the initial circular designs is shown in Exhibit A-5b. For installation, this strike would require the boring of two concentric holes. Concurrently with these initial designs, Mr. Schlage initiated a patent search to see what inventions had previously been claimed in the area of bore-in strikes. "Maintaining an awareness of competitive patents is part of the game of inventing," notes Mr. Schlage. "When designing new products, one always hopes that his good ideas are original and were not previously patented by others working in the same field. Avoidance of patent infringement becomes a very important consideration by the designer if he is to spare his company expensive litigation."

Basically, a patent is made up of three parts: the illustrations, the description, and the claims. The first two are included as explanatory background material for the claims; it is the claims which legally describe and bound the invention. Each claim is a single sentence made up of a number of distinct phrases called "elements". A patent claim is said to be infringed by a device which embodies features described by *every* element of that claim. If the device lacks even one feature described by one of the elements, the device does not infringe that claim. Stated legally, "Avoidance of an element of a claim avoids infringement." Mr. Schlage explained, "You try to write your claims as short as possible. Long claims with many elements usually leave loopholes, but if you see a claim written in six or seven lines, you say 'This is a basic claim'."

The patent search turned up two competitive patents of significance to the new project; the first of these (Exhibit A-7) appears to contain basic claims to a flush-mounted circular strike; the circular Schlage prototype would clearly infringe on this patent. The strike described in the second patent was an improvement on Russell's; although he obtained a patent, the inventor could not produce his strike without first obtaining rights to the basic strike patented by Russell.

With the Russell patent appearing to discourage further development of the first circular prototype, Mr. Schlage began

compiling an up-to-date set of design criteria for the new strike. He felt that the jamb preparation should be possible by boring along a single axis, and should provide for flush mounting of the strike. The strike should be reasonably low in cost, yet attractive and strong enough to withstand high rebound forces. It should preferably provide sufficient allowance for door sag (now lacking on both the Schlage prototype and the patented Russell strike). The newest criterion, of course, was that the new strike must not infringe the Russell patent.

Note: Part B of ECL 114 describes the steps taken which resulted in the design and introduction of a new circular strike meeting all of the above requirements.

Exhibits, Section A

Exhibit A-1	"Old Catalogue Page Showing Mortise Locks"
Exhibit A-2	"Typical Cylindrical Lock Assembly"
Exhibit A-3	"Strike Plates"
Exhibit A-4	"Typical Latching Arrangement"
Exhibit A-5a	Photograph, "Trapezoidal Prototype"
Exhibit A-5b	Photograph, "First Circular Prototype"
Exhibit A-6	"Mr. Schlage's Sketches of Fastening Schemes" (2 pages)
Exhibit A-7	Russell Patent No. 2,937,898 (3 pages)

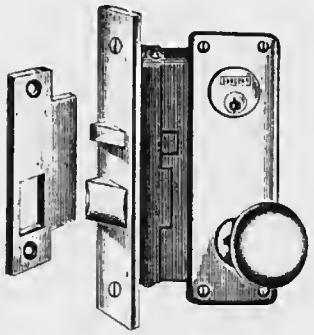
MORTISE CYLINDER LOCKS

HEAVY LINE

MR—MADISON DESIGN LOCK SETS

COLD FORGED BRONZE (.048 GA.)

OFFICE OR CLASSROOM LOCKS



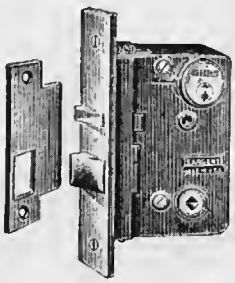
Nos. 7705½ MR and 7737 MR-MKD

One pair knobs, inside and outside 1653. Cylinder ring 98. Escutcheons, inside 7875½ MR, outside 7876 MR. Spindle 1635—4½ inch. Lock 7705½ N or 7737 N. Master keyed to Master Key No. LB 17400 xM.

No.		Finish	Per Set
OP 7705½	MR—Office Doorlock	Dull Bronze	$28.00
OP 7737	MR—Classroom Lock	Dull Bronze	31.50

SCHOOL HOUSE LOCK

No. 7737 N



For classroom doors. Always operative from inside. Flat front. Fronts can be beveled at any angle from flat to ⅛ inch in 2 inches. Thickness of door should be specified. One bronze cylinder. Bronze hubs for ⅜ inch swivel spindle. Bronze bolt, ½-inch throw. **Size** — Lock, depth, 4 in.; height, 5⅝ inches; thickness, ¾ inch; 2¾-inch Backset Faceplate, 1¼ x 8 inches with 1¼-inch strike.

Operation: Inside at all times by knob. Key on outside cylinder permits operation of knob outside or makes outside knob stationary as desired.

One in box—weight 3¼ lbs.

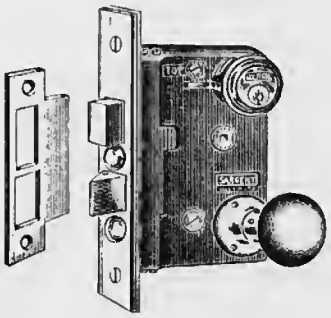
No.	Finish	Each
OP 7737 N	Dull Bronze	$22.00

Furnished with 2 Keys, No. 267.

SECTIONAL LOCK SET FOR ENTRANCE DOORS

Outside with Cylinder, Inside with Turn Knob

Set No. 1-6745



One-piece wrought bronze and brass knobs. Roses, key escutcheons and turn knobs wrought bronze and brass. With metal knobs. Lock 6745N, Inside and Outside Knobs 1773, Inside and Outside Roses 554, Wrought Bronze and Brass Cylinder Ring 98, Turn Knob 125, Spindle 1635—4½ in.

One set in box, weight 3¾ lbs.; 6 sets in case, weight 25 lbs.

No.	Finish	Per Set
B 1-6745	Polished Brass	$19.15
OP 1-6745	Dull Bronze	19.15

OFFICE LOCK

BRONZE FRONT — HEAVY BOLTS

No. 7705½ N

Flat front with guarded bolt and dead locking stop. Fronts can be beveled at any angle from flat to ⅛ inch in 2 inches. Thickness of door should be specified.

One bronze cylinder. Bronze hubs for ⅜-inch swivel spindle. Bronze bolts—½-inch throw. **Size** — Lock, depth, 4 inches; height, 5 inches; thickness, ¾ inch; 2¾-inch Backset. Faceplate, 1¼ x 8 inches, with 1¼-inch strike.

Operation: From outside by key, both sides by knobs. Outside knob is set by lower stop in face of lock and can be released only by pushing in upper stop.

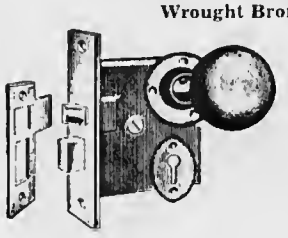
One in box, weight 3 lbs.

No.	Finish	Each
OP 7705½ N	Dull Bronze	$20.00

Furnished with 2 Keys, No. 267.

FRENCH DOOR LOCK SET

Wrought Bronze and Brass



Set No. 1-5134, Bit Key 1½-Inch Backset

With No. 5134 Lock, No. 1772 Knob, **No. 1119 Lever Handle** and No. 710 Key Escutcheon. No. 906 steel key. Packed one set in box, with screws.

Set No.	Finish	Weight per Doz. Sets	Per Doz. Sets
B I-5134	Polished Brass	23 lbs.	$82.00
OB I-5134	Dull Brass	23 lbs.	82.00
OP I-5134	Dull Bronze	23 lbs.	82.00

MORTISE FRENCH DOOR LOCKS

Bronze Front and Strike

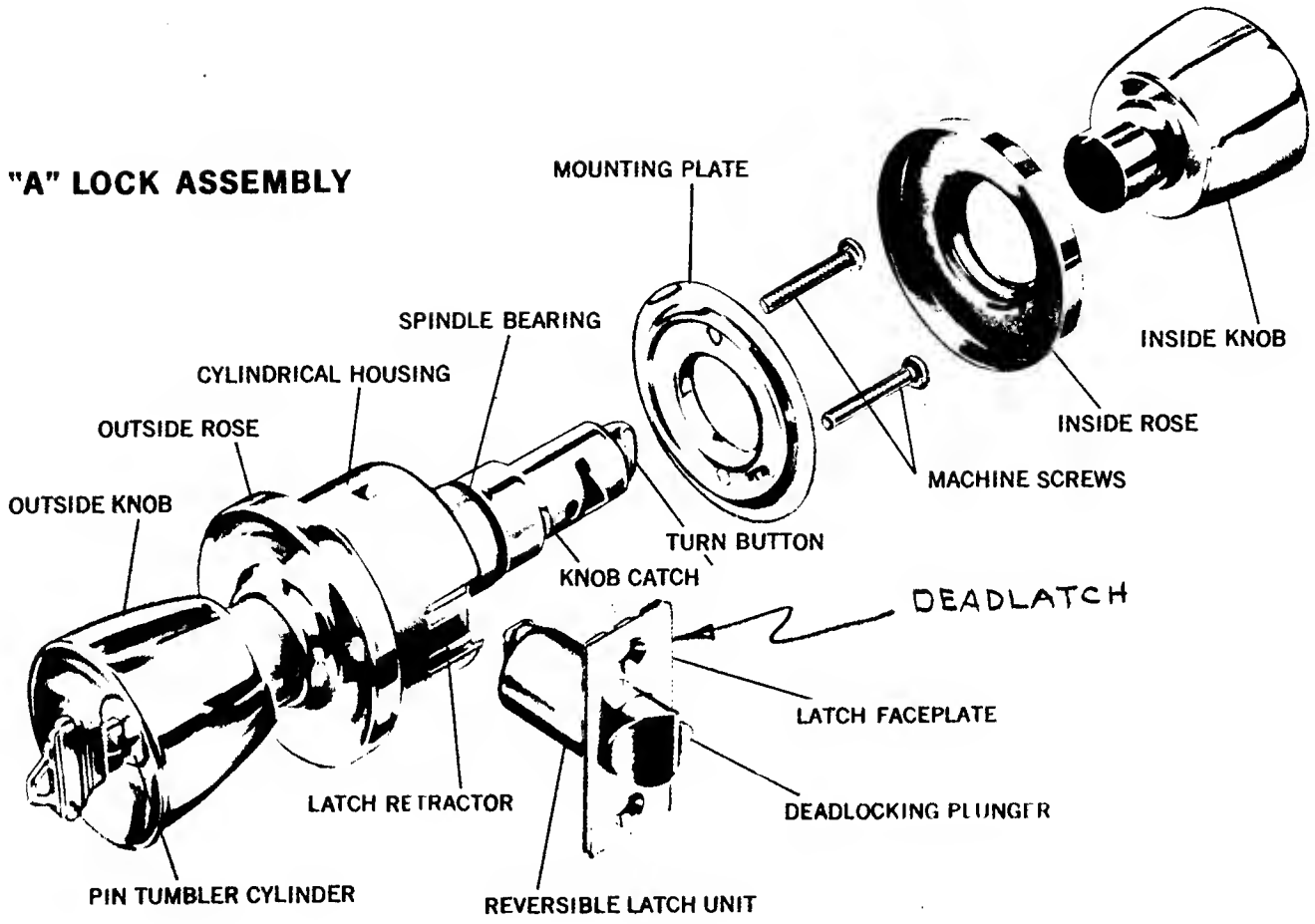
No. 5134

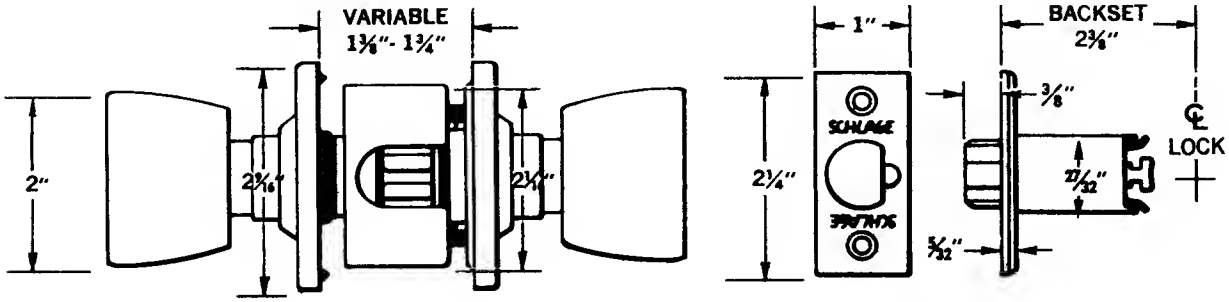
Spring on the hub is made extra heavy to hold up lever handle. Latch and dead bolt have ⅝ inch throw. Reverse, flat front, by removing cap. Bronze hub for ⅜ inch straight spindle, heavy bronze bolt. **Size** — Lock: depth, 2 inches; height, 3⅝ inches; thickness, ½ inch, 1½-inch Backset. Faceplate, 5 x 1⅜ inches with ⅞-inch strike. No. 906 steel keys. 12 key changes. Wrought steel tumblers. Packed 6 in a box. Weight per box, 6½ lbs.

No.	Finish	Each
B-5134	Polished Brass	$5.90
OB-5134	Dull Brass	5.90
OP-5134	Dull Bronze	5.90

Exhibit A-1 "Old Catalogue Page Showing Mortise Locks"

A LOCKS *specifications*

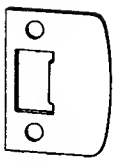




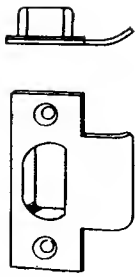
"A" LOCK DIMENSIONS . . . Shown in the illustration above are the over-all dimensions for the standard "A" series lock. Dimensional variations resulting from different ornamental designs or special conditions are shown on pages specifically related to the subject.

Exhibit A-2 "Typical Cylindrical Lock Assembly"

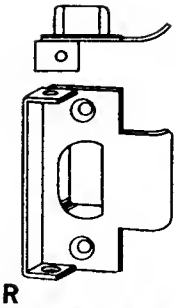
STRIKES



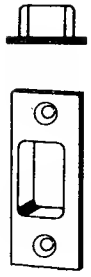
990
Standard Strike
SIZE: 2¼" high
LIPS: Full Lip



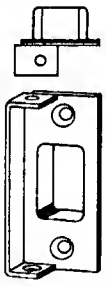
951
Standard Box Strike
SIZE: 2¾" x 1⅛" x 3/32" thick
LIPS: ⅞" through 4" in ⅛" graduations



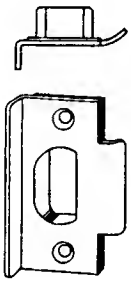
951R
Standard ⅜" or ½" Rabbeted Box Strike
SIZE: 2¾" x 1⅛" x 3/32" thick
LIPS: ⅞" through 4" in ⅛" graduations
(Strike shields may be ordered separately. Specify finish and depth of rabbet.)



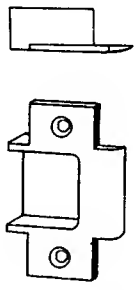
952
Standard Box Strike
SIZE: 2¾" x 1⅛" x 3/32" thick
(For use with deadlocks)



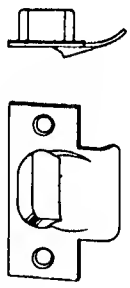
952R
Standard ⅜" or ½" Rabbeted Box Strike
SIZE: 2¾" x 1⅛" x 3/32" thick
(For use with deadlocks)
(Strike shields may be ordered separately. Specify finish and depth of rabbet.)



953
Protected Back Box Strike
(For 1⅜" and 1¾" doors only)
LIP: 15/16" for 1⅜" doors
LIP: 1¼" for 1¾" doors



954
Cast Open Back Strike
SIZE: 2¾" x 1⅛" x ⅛" thick
LIP: 1" (For 1¾" thick doors)



955
Raised Lip Box Strike
SIZE: 2¾" x 1⅛" x 3/32" thick
LIPS: 1¼" through 4" in ⅛" graduations

All Schlage strikes are reversible and are furnished complete with screws. Lip strikes, with the exception of the 953 and 954, are furnished with 1¼" lip as standard. Rabbeted door frames and rabbeted latch bolts require rabbeted strikes. Rabbeted strikes for hollow metal doors and other special strikes can be made to order.

To accurately determine the length of lip required for a strike, measure from the center line of strike to the end of door jamb as shown in the illustration. This dimension, plus ¼" for curved lip jamb clearance, is the required lip length. When ordering, specify strike number, finish and lip size.

ORDERING EXAMPLE:

10	960	3	1½" LIP
Quantity	Catalog No.	Finish	Detail

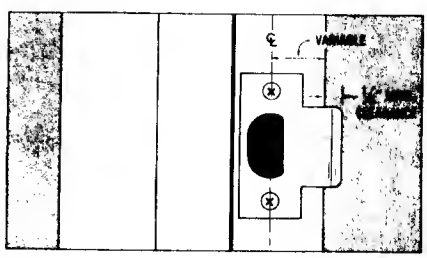


Exhibit A-3 "Strike Plates"

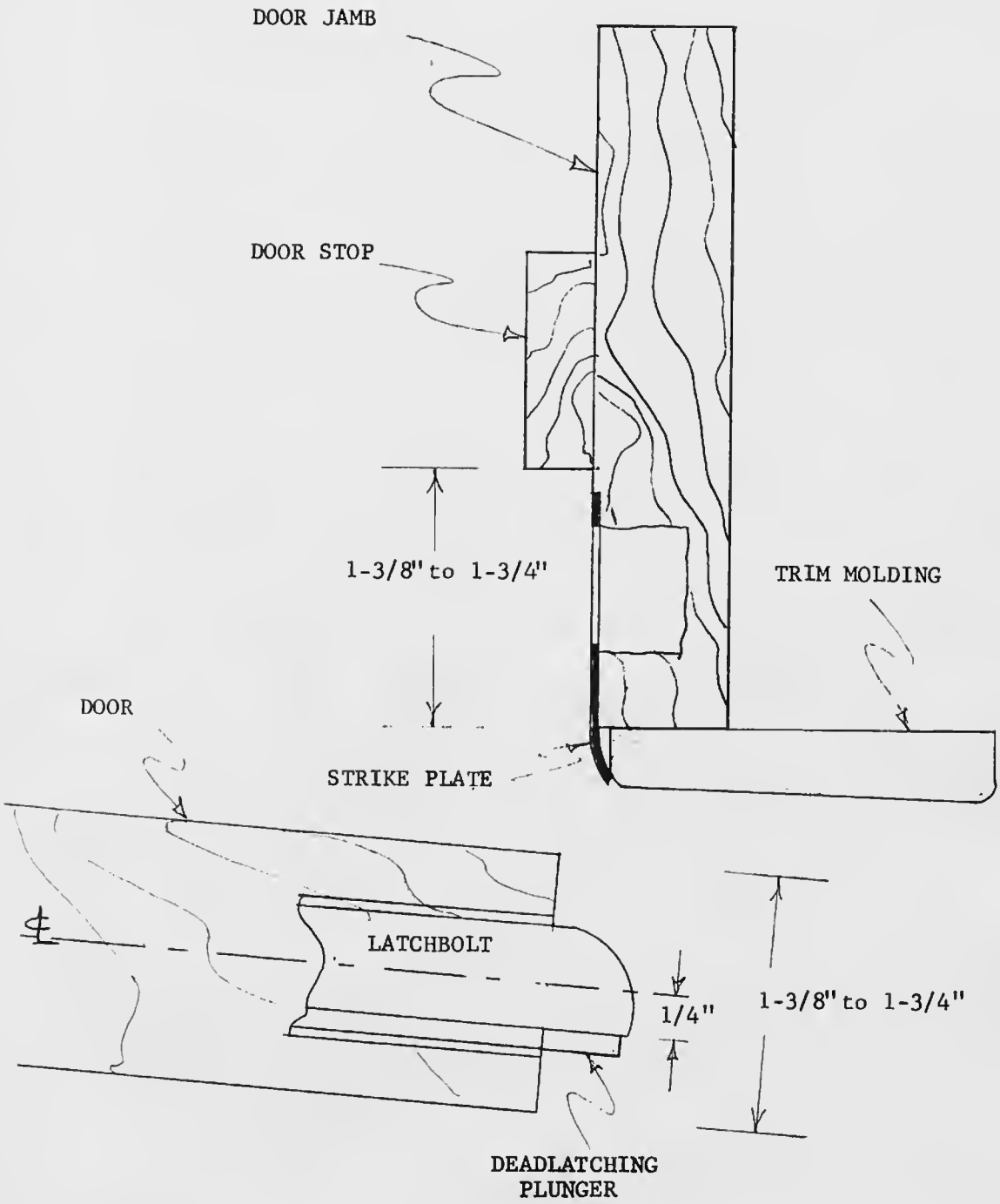


Exhibit A-4 "Typical Latching Arrangement"

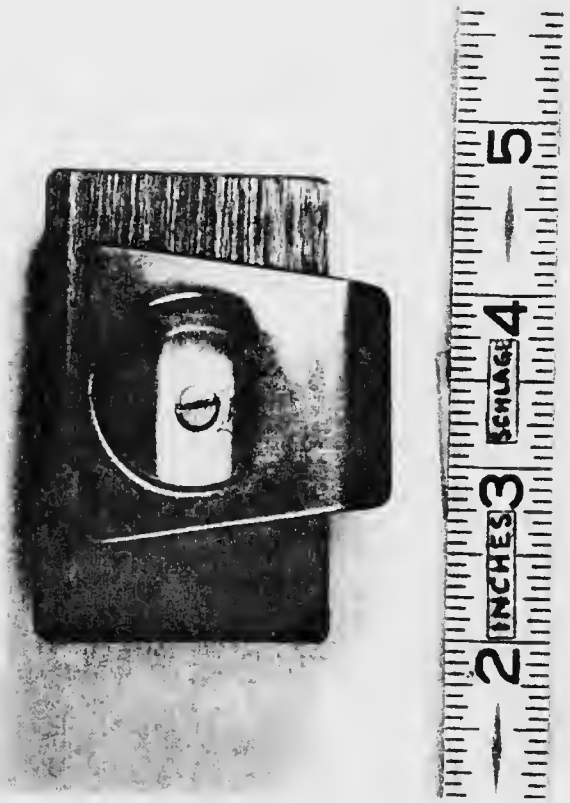


Exhibit A-5a

Photograph, "Trapezoidal Prototype"

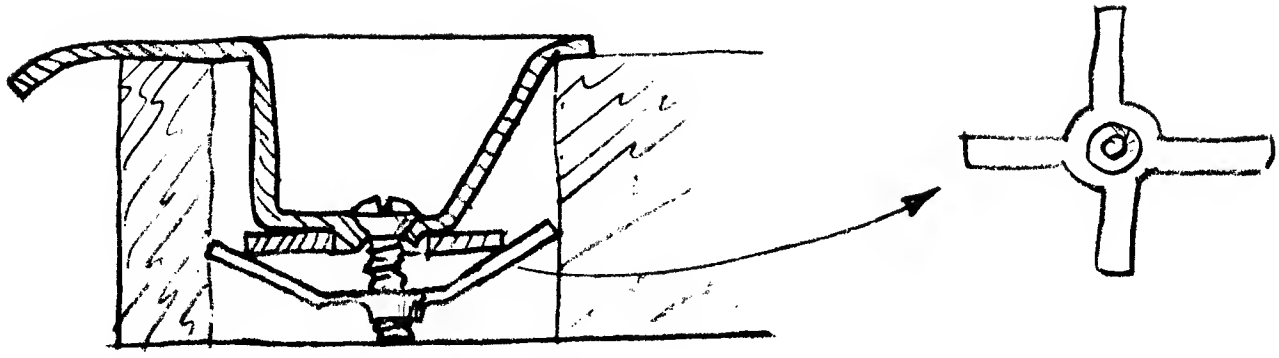
Exhibit A-5b

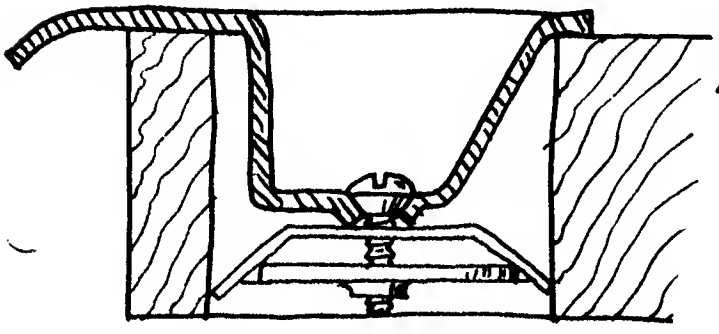
Photograph, "First Circular Prototype"

11 'ay

Friday, January 11, 1963

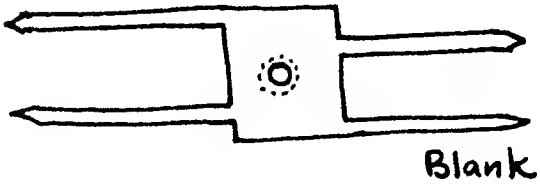
354 days follow





This design, although more difficult to insert into the hole, has the advantage that it draws or pulls the strike down into the hole as the screw is tightened.

E L Schlage Jan 11, 63



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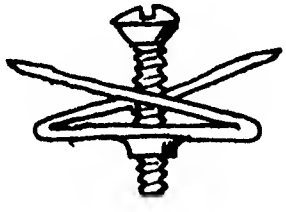


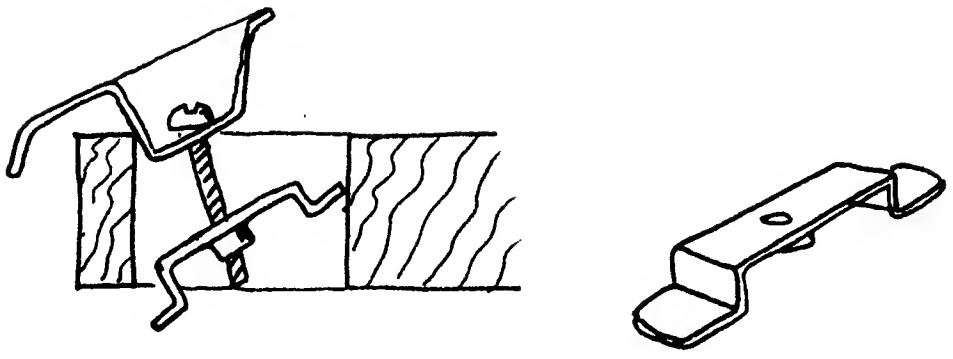
Folded up.

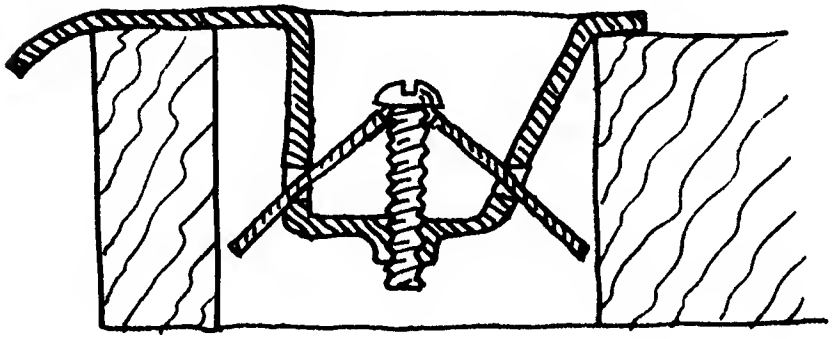
Exhibit A-6 "Mr. Schlage's Sketches of Fastening Schemes" dated 11 Jan. & 14 Jan., 1963

1 ' ' day

Monday, January 14, 1963

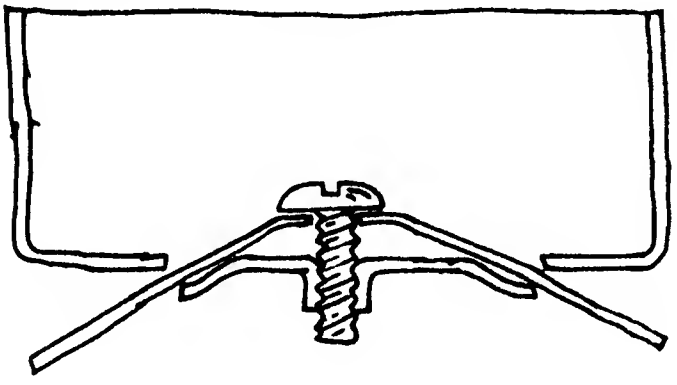
351 days follow





E L Schlage
Jan 14, 1963

Tightening screw causes legs to bite into wood around hole and to draw strike down flush.



Model made.

Exhibit A-6 "Mr. Schlage's Sketches of Fastening Schemes"

May 24, 1960 F. J. RUSSELL 2,937,898

CIRCULAR STRIKE INSTALLATION

Filed Jan. 28, 1958

FIG. 1.

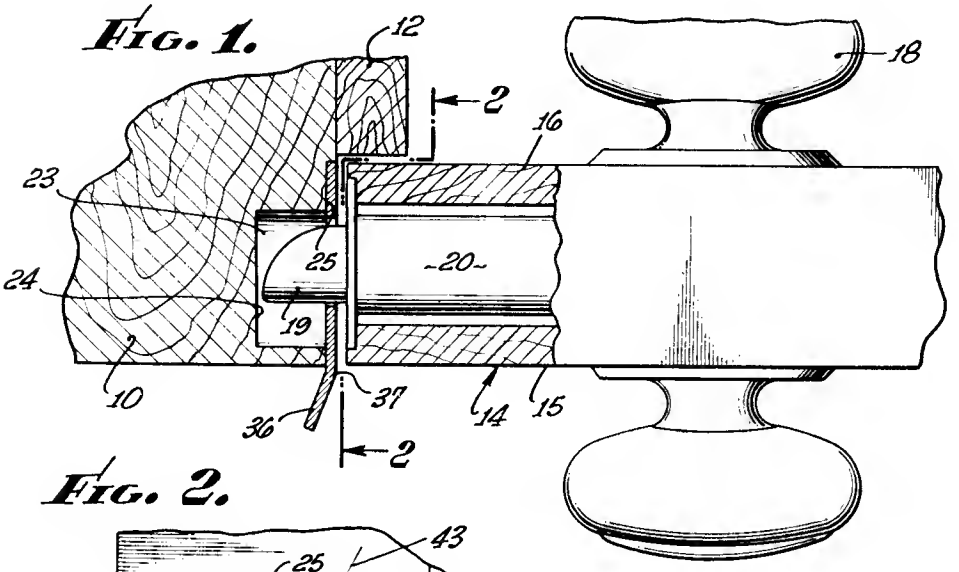


FIG. 2.

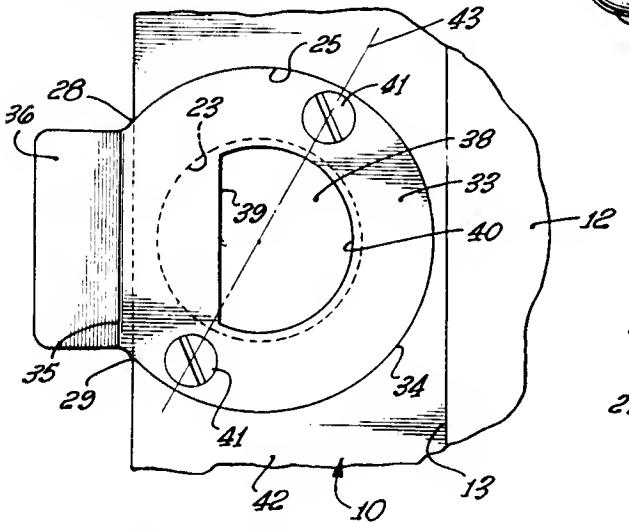


FIG. 3.

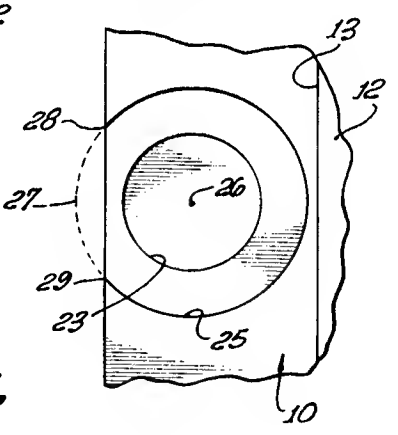


FIG. 4.

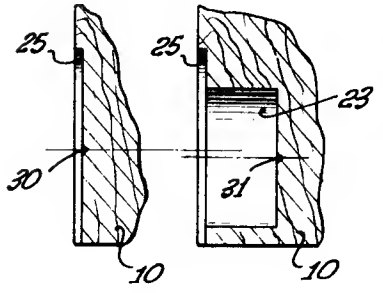
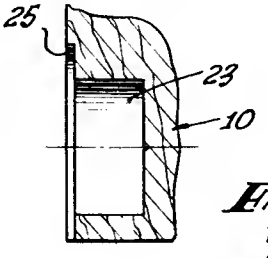


FIG. 5.



INVENTOR.
FRED J. RUSSELL
BY
Beehler & Shanahan
ATTORNEYS.

Exhibit A-7 Russell Patent 2,937,898

United States Patent Office 2,937,898
Patented May 24, 1960

2,937,898

CIRCULAR STRIKE INSTALLATION

Fred J. Russell, 3800 Don Felipe Drive, Los Angeles, Calif.

Filed Jan. 28, 1958, Ser. No. 711,615
3 Claims. (Cl. 292—340)

The invention relates to latches, locks and lock hardware and has particular reference to a strike plate for use with such hardware against which the customary latch bolt strikes and engages to hold a door in latched position.

One of the elements which has been a factor of some consequence in the installation of door hardware has been the shape of strike plates which has necessitated careful chiseling to provide square and rectangular apertures so that the strike plate of corresponding configuration can be made to fit snugly and neatly in the aperture. In fine residential and commercial building construction, the fitting of strike plates of the character mentioned takes on the character of fine cabinet work which is often in practice somewhat beyond the ability of an average workman called upon to perform such tasks.

Moreover, the accelerated employment of power tools has taught that where hardware is such that it can be mounted in openings prepared by drilling tools, appreciable time can be saved.

It is therefore among the objects of the invention to provide a new and improved circular strike installation which involves both a method of mounting a strike plate on a door frame by effective, rapid means and a properly designed strike plate of inexpensive construction which is especially well adapted to employment with the method.

Another object of the invention is to provide a new and improved circular strike mounting whereby the frame of a door can be prepared for reception of a strike plate neatly and accurately by relatively simple means and tools which will result in a very workman-like installation even though performed by a person not especially well skilled in cabinet work.

Still another object of the invention is to provide a new and improved circular strike installation which incorporates a specially formed strike plate so constructed that it can be accurately, neatly and effectively mounted in and over recesses which have been formed by circularly revolving tools, the strike plate being moreover such that once installed, the installation is sturdy and rugged to a material degree and thereby capable of withstanding frequent and prolonged jarring such as would normally occur with the opening and closing of a door.

Still another object of the invention is to provide a new and improved means and accompanying device which by virtue of the construction and mode of installation is capable of minimizing to a material degree the cost of installation as well as the attendant cost of the appropriate strike plate hardware item.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device together with the method for achieving the same whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a horizontal view partially broken away showing a door and door frame in closed position and illustrating the mounting and operation of the circular strike installation.

Figure 2 is a fragmentary elevational view of the circular strike plate installation taken on the line 2—2 of Figure 1.

Figure 3 is a fragmentary elevational view showing the recess in the frame ready for reception of a circular strike plate.

Figure 4 is a fragmentary sectional view showing two successive steps in forming the recess for reception of the circular strike plate.

Figure 5 is a fragmentary sectional view showing a modified method for the preparation of a recess for reception of a circular strike plate.

In an embodiment of the invention illustrated in the drawings there is shown a door frame 10 upon which is mounted a door stop 11 spaced from an edge 12 of the door frame so as to leave an area therebetween bounded at one vertical side by the edge 12 and on an opposite vertical side by a face 13 of the door stop.

A door 14 is shown having an outer face 15 and an inner face 16 which is mounted in a conventional fashion to swing within the frame 10. Outer and inner knobs 17 and 18, respectively, are mounted in a conventional fashion for manipulation of a latch bolt 19 which is contained in a conventional latch bolt casing 20 in the door 14.

In the frame, as shown to good advantage in Figures 1 and 3, there is provided a clearance hole 23 having a diameter substantially less than the distance between the edge 12 of the frame and the face 13 of the stop. The depth of the clearance hole 23 is sufficiently great so that a bottom 24 of the hole permits full extension of the latch bolt 19.

A second hole 25 of relatively larger diameter overlies the location of the clearance hole 23. This hole 25 which is of relatively greater diameter may be concentric with respect to the hole 23 in the form of invention illustrated in Figures 1, 2, 3 and 5. It will be noted particularly that the diameter of the hole 25 is greater than the distance between the edge 12 of the frame and the face 13 of the stop 12. Moreover, by locating a center point 26 more nearly the edge 12 than the face 13, the wall of the hole 25 will break through the edge 12 as shown to good advantage in Figure 3 where the outermost portion of the path of a tool (not shown) for making the hole 25 is shown by a broken arcuate line 27. Breaking through the edge 12 in this fashion provides a shallow opening identified by an upper edge 28 and a lower edge 29, as shown in Figures 2 and 3.

In boring holes 23 and 25 in the event separate bits or drills may be employed, it is advantageous to first bore the hole 25 which is of relatively large diameter and thereafter bore the hole 23 which is of relatively smaller diameter. In the event that the holes are to be concentric, the bit or drill in each instance will be centered at the same center point 26. Where the centers are concentric, it may on occasions be advantageous to make use of a step drill of conventional form (not shown) thereby to bore both of the holes in a single operation and by use of a single tool. The method employing a step drill may be more particularly effective where material comprising the frame 10 is something other than wood.

On some occassions it may be desirable not to have the relatively larger hole 25 concentric with the relatively smaller hole 23. Under such circumstances it is most advantageous to first bore the hole 25 about its center 30. Thereafter the hole 23 can be bored about its center 31 which may be offset a slight distance from the center 30. By drilling the hole 25 first, a portion of the ma-

terial of the frame 10 will be left remaining in order to effectively center the tool for boring the relatively smaller hole 23. In this last described method as in the order of procedure first indicated, the location of the center 30 of the hole 25 will be more nearly the edge 12 of the frame than the face 13 of the stop.

Regardless of the manner or order of boring of the holes 25 and 23, the mounting of a circular strike plate 32 is substantially the same.

The strike plate itself comprises a frame-engaging portion 33 which is flat and which is provided with a perimeter 34 which is a partial circle. At one side of the frame-engaging portion, namely, a side 35, is a strike lip 36 which is composed of the same sheet material and is bent over as indicated in Figure 1 in a substantially conventional fashion. The frame-engaging portion, however, is made to extend toward the strike lip a distance such that the line 37 where the bend takes place extends outwardly beyond the edge 12 of the door frame 10. In conformance with the circular patterning there is provided in the frame-engaging portion a recess 38 for reception of the latch bolt 19 which has a straight edge 39 and a semi-circular edge 40.

For fastening the strike plate to the door frame there are provided screws 41 which extend through appropriate countersunk screw holes in the strike plate, details of which have been omitted. It is significant, however, that the screws are located on opposite sides of a diametric line 42 through the center of the frame-engaging portion 33 in a direction parallel to the edge 12. The screws may be considered as lying upon an axis 43 which lies oblique with respect to the diametric line 42. By mounting the screws in this relationship, the tendency of the strike plate to tilt as a result of having the lip struck repeatedly by the latch bolt is substantially minimized.

The installation herein described will, when employed with a strike plate having a substantially circular frame-engaging portion, make possible the mounting of such a strike plate on a door frame ready for installation with extreme rapidity and result in an appropriate saving in time and money to the ultimate consumer. As is apparent, by making use of perfectly circular mounting holes, modern power tools can be used to the greatest possible advantage.

While I have herein shown and described my invention in what I have conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of my invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent devices.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A circular strike mounting comprising a door frame having a straight edge on one side, a door stop on the frame and an area of predetermined width between the stop and the opposite edge of the frame, a relatively shallow hole of diameter between opposite curved portions greater than the width of said area bored into the frame at a location intersecting said opposite edge and forming a recess in said opposite edge of length less than the diameter of said shallow hole, said opposite curved portion having points of intersection with said edge at oblique angles, a relatively deep clearance hole concentric with said shallow hole, said clearance hole having a diameter smaller than said width and being located entirely within said area, and an apertured strike plate of sheet metal of uniform thickness and having a frame-engaging portion of substantially the same diameter as said shallow hole, said frame-engaging portion being positioned in said shallow hole, a recess in the strike plate concentric with both said holes and having a straight side parallel with said straight edge, and a portion of said strike plate partially overlying said clearance hole and lying partially in said recess, the said rim portion having an extension disposed in an oblique direction protruding beyond said opposite edge and forming in strike lip.

2. A circular strike mounting comprising a door frame, a door stop on the frame and an area of predetermined width between the stop and the opposite edge of the frame, a relatively shallow hole of diameter greater than the width of said area bored into the frame at a location intersecting said opposite edge, and forming a recess in said opposite edge having a length less than the diameter of said shallow hole, said hole having a continuously curved wall of uniform radius with ends terminating at opposite ends of said recess, a relatively deep clearance hole concentric with said shallow hole, said clearance hole having a diameter smaller than said width and being located entirely within said area, and an apertured strike plate having a frame-engaging portion of substantially the same curvature and diameter as said shallow hole, a straight edge on said frame engaging portion coincident with said recess, said frame-engaging portion being positioned in said shallow hole and a rim portion joined to the frame engaging portion at said straight edge, said rim portion having a location protruding beyond said opposite edge, a strike lip on said rim portion and screw holes for reception of screws lying on a centering line oblique relative to a diametric line drawn through said strike plate in a direction parallel to said opposite edge.

3. In a door frame having a stop thereon and an edge on the opposite side of said frame spaced from said stop, a method of outfitting said door frame for operation with a latch bolt comprising simultaneously boring concentric holes in the frame between said stop and said edge, making one of said holes relatively shallow and of relatively larger diameter and making the other of said holes relatively deep and of smaller diameter, locating the centers of said holes near enough to said edge so that said one hole when bored cuts through said edge forming an opening and avoids cutting said stop and so that said other hole is spaced inwardly from said edge leaving a portion of the frame between the hole and said edge, forming a strike plate of sheet material with a curved perimeter of the same curvature and depth as said one hole and forming on one side of the plate a strike plate having a junction with the plate of the same length as said recess and tilting said lip from the plane of said plate, forming a latch bolt aperture in said strike plate concentric with the curved perimeter and of diameter smaller than said perimeter, forming one straight side on said latch bolt aperture parallel to the junction of said lip with said plate, placing said plate in said relatively shallow hole so that the lip extends through the recess and a portion of the plate adjacent said one straight side overlies a part of said other hole, and anchoring said plate to the frame.

References Cited in the file of this patent

UNITED STATES PATENTS

1,553,531	Hoffman	Sept. 15, 1925
2,112,909	Jackson	Apr. 5, 1938
2,272,241	Fendring	Feb. 10, 1942
2,448,293	Berini	Aug. 31, 1948
2,656,205	Fletcher	Oct. 20, 1953

DEVELOPMENT OF A CIRCULAR STRIKE PLATE AT THE SCHLAGE LOCK COMPANY (B)

"The revolutionary aspect of our circular strike is the fact that the main bored hole, the hole that accepts the strike box, breaks out. We obtained a really basic patent on this idea and we have been able to stop infringers," states Mr. Schlage.

After carefully examining the Russell patent, Mr. Schlage had listed three ways to produce a similar strike without infringement:

1. *Curve* the edge which contacts the latchbolt.
2 Align the fastening screws *vertically* rather than inclined.
3. Make the strike lip part of the rim itself, rather than an "extension" of the rim.

None of these changes, however, would permit a significant improvement over previous bore-in strike concepts in terms of sag allowance, which appeared to be limited by the available width on the door jamb. To be compatible with the latchbolt location in the door, the bolt receiving hole should be offset toward the frame edge (as seen in the Russell patent, Figure 3), rather than centered between doorstop and frame edge. This meant that for narrow door installations, even a one inch diameter bolt receiving hole would come very close to the frame edge.

Mr. Schlage suddenly realized that it might make good sense for the bolt receiving hole to be large enough actually to break through the edge of the frame. While this meant the hole would show on the front edge of the raw door frame, most frames are finished with a "molding strip" to cover the joint between wall and frame. This strip could be butted against the back of the strike lip to hide the bolt receiving hole. Mr. Schlage re-examined the Russell patent and found it clearly specified that the smaller, deeper hole was to be located "entirely within" the area between the doorstop and frame edge.

Mr. Schlage emphasized that this "breakthrough" had more value than just its patentability, "It made our circular strike superior, because our latchbolt receiving opening could be larger, particularly in the vertical direction. Previous circular strikes had very little provision for sag. That is very important. We have as much allowance for sag as on our standard strikes."

After Mr. Schlage suggested the basic concept, other members of the Research staff evolved specific design proposals. A number of these are summarized on the Project Review sheet included as Exhibit B-1. During the five weeks from April 15 to May 20, a final detail design was developed based on the results of prototype tests. Schlage has mechanical equipment to carry out over 45 tests on door locking parts; strikes are usually subjected to "door slam" and "kick" tests, which indicate a strike's strength and holding power in the jamb, and to wear tests, which determine how well the strike's finish stands up under the abrasive action of the latchbolt. A description of the standard kick test is included as Exhibit B-2.

As anticipated, fastening proved to be a problem. Like the earlier trapezoidal prototype strike, the circular strike would have an integral strike box. However, since the receiving hole broke out, schemes such

as those considered earlier (Part A) could not be used. To achieve adequate sag allowance, the strike had to be fastened through the strike box, for if fastened through a rim, the rim would necessarily become too large for narrow door installations—that is, the doorstop limits the maximum diameter of the rim which can be used. Screws through the strike box walls had to be placed at an angle which would permit access with drill and screwdriver. This meant the screw or screws had to be installed through a wall which slanted inward toward the bottom of the strike box. The conical strike box suggested in concept 1 of Exhibit B-1 would permit an acceptable screw angle; however, the conical wall, if carried around to the bolt-receiving wall, would severely limit sag allowance.

Schlage engineers solved this problem by forming the strike box wall of intersecting sections of a cone and cylinder. One anchoring screw was located at the rear (conical) wall, which met cylindrical sections extending from the front (flat) bolt-contacting wall. The single fastening screw would not be required to carry the entire load to the jamb; an outer skirt on the strike would fit into the outer groove of a "trepan" hole to transmit much of the force to the frame. This trepanned hole required the design of a tool to bore three holes of different depths and diameters on the same axis, as shown on the installation sheet (Exhibit B-3).

Several prototypes of the one-screw, trepan-hole model were made (concept 10 in Exhibit B-1); the Research group members were enthusiastic about both its appearance and solidity when fastened. On May 20, 1963 the drawing included as Exhibit B-4 was approved for pilot run production of the new strike.

Mr. Schlage was later awarded extensive patent rights in connection with the new circular strike; excerpts from his patent are shown in Exhibit B-5. In discussing the design phase of the strike, he emphasized that several innovative features in addition to the larger sag allowance should contribute to its commercial success. The integral strike box scheme, while practically required from a security standpoint (without a strike box to establish the depth of the bolt receiving hole in the jamb, it might be bored too shallow), carried several additional benefits, the most marketable of which was probably its fine appearance. The new strike also promised to be cheaper to produce than earlier strike box assemblies, since only one piece of metal would be involved (previously the strike box had been a separate piece which had to be fastened to the strike), and since the strike box would add considerable strength to the bolt receiving edge, thus permitting the strike to be made of thinner metal with no loss of strength.

Another novel feature of the Schlage circular strike was the skirt designed to fit into a trepan hole. Coupled with the integral strike box, the presence of the skirt gives the strike an appearance of solidity compatible with Schlage's reputation for quality hardware. When located (as recommended) in a trepan hole, the strike withstood an extra 50 pounds force in the kick test as compared to the alternate (non-trepan) installation (see Exhibit B-3).

Production Problems

The initial batch, or "pilot run" of circular strikes was produced by the Larkin Specialty Manufacturing Company of

South San Francisco. Mr. Schlage explained that frequently the pilot run of a new product is produced outside the company; "The Production Engineering group is understandably not always enthusiastic about the new products we develop. Their staff and equipment are kept busy enough by the items already in production, so we usually hear some grumbling from them when we release a new product, often to the effect that it's impossible to produce the part economically. We knew this circular strike would be no exception, as it requires a deep draw of rather complicated shape, and a secondary operation is required to countersink the strike box for the fastening screw. By subcontracting the pilot run of the circular strike, the company would be able to test the marketability of the new product without having to commit expensive production facilities to the project at once. This plan would also eliminate some of the headaches involved in the development of production tooling."

Bids were solicited from a number of local manufacturing companies, on lots of both 5,000 and 50,000 units. Of the 12 companies given the opportunity to bid, 10 actually did. There was wide variation in the bids received; the highest bid was 4 1/2 times the lowest. Larkin submitted the second lowest bid, with the lowest unit labor cost, meaning that their tooling estimate was higher than that of the lowest bidder. On May 31, Larkin was awarded a contract to produce 5,000 of the circular strikes; they won the contract because it was felt that their more expensive tooling would mean less difficulty in producing the strikes within the required tolerances. It was agreed under the terms of the bidding that Schlage would supply the material from which the pilot run of strikes would be produced. During the three weeks that Larkin had indicated they would need for tooling, Schlage shipped them two large rolls of the proper size material (3" wide, .035" thick). One roll was a "cartridge brass" (70% copper, 30% zinc), the other "commercial bronze" (90% copper, 10% tin).

Larkin's low bid had been based on the conviction that they could produce the integral strike box with a single "draw". Drawing is a forming operation performed on sheet metal by a punch and die system located in a heavy "punch press" which develops the forces necessary to deform the metal. A strip of sheet metal is fed between the punch and die by a mechanical feed system which is coordinated with the punch action. As the strip stops under the punch, a holding ring lowers against the sheet metal and clamps it. The punch is then forced into the sheet metal, which is deformed into the die. The holding ring must clamp just tightly enough that some of the metal is allowed to flow from under it without forming wrinkles as it moves toward the edge of the die cavity.

More than one draw may be required to achieve a finished piece, depending on the type of metal and its desired final shape. When Larkin began a test run with their single draw system, they were dismayed to find that the punch consistently broke through the bottom of the strike box. Larkin reported this problem to Schlage, suggesting that perhaps annealing the material would improve the results. The testing group at Schlage's Research Division carried out annealing tests on several Schlage production materials. They found from these tests that their 111-2350 cartridge brass could be formed in one draw when annealed for 15 minutes at 750 degrees F; they also found

that their 111-2500 brass could be formed in one draw without annealing.

About 600 pounds of the 111-2500 brass was delivered to Larkin during the last week of June. Meanwhile, Larkin had proceeded to anneal the rest of the original roll of brass, after which the strikes could be formed in one draw; but an orange-peel effect was noticed on the material after drawing and the entire roll had to be scrapped. 5,000 strikes were successfully produced from the second shipment of material and delivered just in time to satisfy several urgent customer demands.

The pilot run of circular strikes was generally received with enthusiasm by Schlage customers, and the company decided to set up their own production facilities for the new item. Production Engineering designed a seven station progressive die to form the basic strike; a second operation formed the screw countersink. The new die was constructed by an eastern die shop which specializes in carbide dies and was put in service during July 1964 without further incident.

Mr. Schlage later summarized the first circular strike project. "The new strike proved to be very popular with several large pre-hung door mills, particularly because of its appearance, allowance for sag, and ease of installation. There were even indications that door mills which did not normally furnish Schlage locks would purchase this circular strike for use with other brands of locks, a practice unheard of in the industry.

Some problems which later developed resulted from the inability of some of our customers to install the strikes as accurately as necessary; these customers were having problems with door rattle and with strikes tilting up due to improper fastening screw angle. Also, in a few instances where strikes were installed for use with thick doors, the latchbolt, during closing of the door, would contact the trim molding before the strike lip, thus scoring the molding. We suspected that we would eventually have to provide a strike which was not susceptible to these problems."

Note: Part C of ECL 114 describes efforts to modify the circular strike in the attempt to correct the above-mentioned problem.

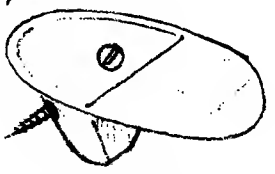
Exhibits, Section B

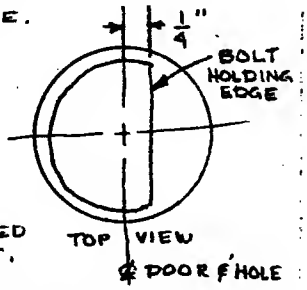
Exhibit B-1	"Circular Strike Project Review Sheet"
Exhibit B-2	"Door Kick Test"
Exhibit B-3	"Installation Sheet"
Exhibit B-4	"Circular Strike Production Drawing"
Exhibit B-5	"Excerpts from Schlage Patent No. 3,159,416" (3 pages)

SCHLAGE LOCK COMPANY - RESEARCH DIVISION - PROJECT REVIEW

PROJECT NO. RP 6301 , PATENT FILE NO. 377

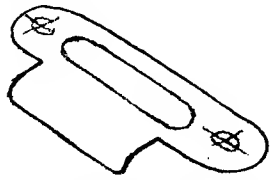
1. CONICAL SHAPED STRIKE BOX, CIRCULAR STRIKE PLATE. FOR CONICAL HOLE. 3/15/63





THIS CONSTRUCTION LIMITED DOOR SAG ADJUSTMENT.

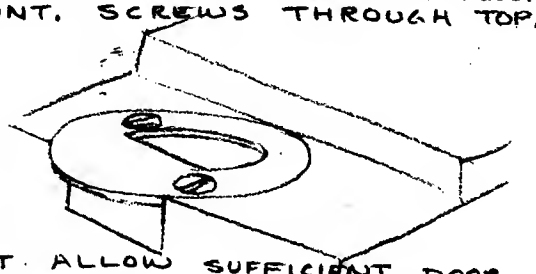
2. OVAL SHAPED STRIKE



THIS DESIGN REQUIRED OVERLAPING DRILLS TO BORE THE COUNTERBORE

3/15/63

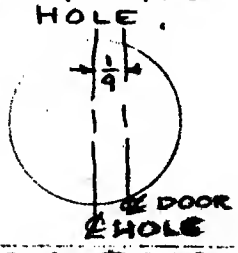
3. SINGLE BORED HOLE WITH FLUSH MOUNT. SCREWS THROUGH TOP.



DID NOT ALLOW SUFFICIENT DOOR SAG ADJUSTMENT.

RS-0062 3/19/63

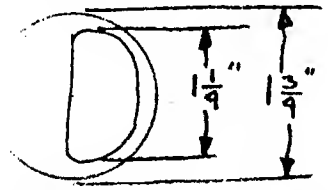
4. SIMPLE CIRCULAR STRIKE BREAK THROUGH ALLOWING ℄ OF HOLE TO MOVE TO THE FACE OF THE BOLT HOLE.



POOR APPEARANCE

3/20/63

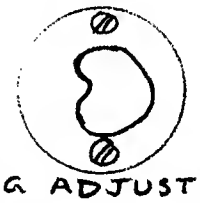
5. SINGLE BORED HOLE WITH "A" STRIKE ADJUSTMENT FOR DOOR SAG.



FASTENING PROBLEM

RS-0062 B 3/20/63

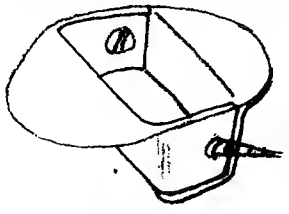
6. ADJUSTMENT FOR DOOR RATTLE AND ATTEMPT TO ELIMINATE FLAT STRIKE EDGE



RS-0064 3/25/63

POOR SAG ADJUSTMENT

7. A FASTENING SOLUTION WITH FOLDED DESIGN

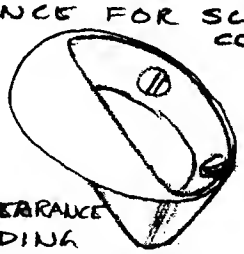


3/25/63

RS-0065

NO CLEARANCE FOR SCREW COUNTERSINK.

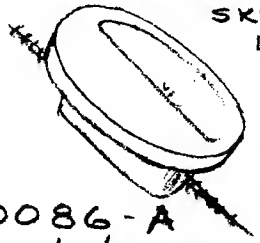
8. DRAWN CUP WITH TAPERED BACK SIDE ALLOWING SOME CLEARANCE FOR SCREW COUNTERSINK.



RS-0085 4/3/63

POOR APPEARANCE
POOR HOLDING ABILITY.

9. CIRCULAR STRIKE, DRAWN BOX, SCREW IN BACK @ 180° SKIRT AROUND EDGE. TREPAN HOLE,



RS-0086-A 4/11/63

10. # 9 WITH 1 SCREWS @ ℄ OF BACK RS-0086-B 4/15/63

11. # 9 WITH 2 SCREWS @ 60° ANGLE IN BACK RS-0086-C 4/19/63

FINAL SETTLEMENT ON # 10

Exhibit B-1 "Circular Strike Project Review Sheet"

STANDARD TEST METHOD

2.21 DOOR KICK TEST

Purpose:

1. To determine the effect on a lock of a sudden impact applied to a closed door simulating kicking the door or pushing the door with the shoulder.
2. To compare lock strength with door and door frame strength.

Procedure:

1. Install lock in test door.
2. Close door.
3. Raise 25 lb. hammer 2", then drop onto impacter.
4. Repeat step 3 with hammer raised in 1" increments, ie., 3", 4", 5", etc. Maximum drop height to be determined at each test.
5. After each hammer drop observe for any damage, loosening, or shifting of lock unit, latch, strike, screws, door, or door frame.

Record:

1. Weight of hammer: 25 lbs.
2. Height from which hammer was dropped, inches. (See sketch).
3. Appearance and condition of lock unit, latch, strike, screws, door and door frame after each hammer drop.
4. Thickness and type of door.

Test Equipment:

1. Test door.
2. Kick fixture.

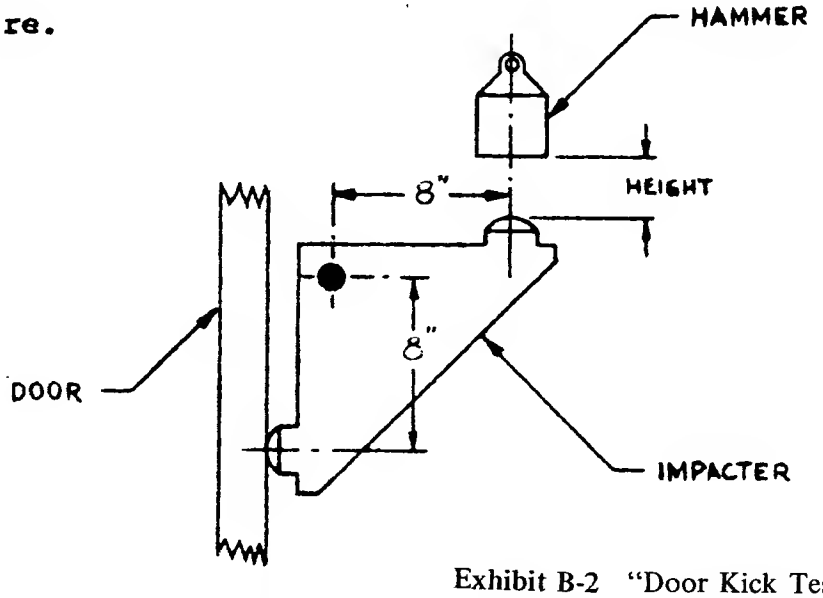
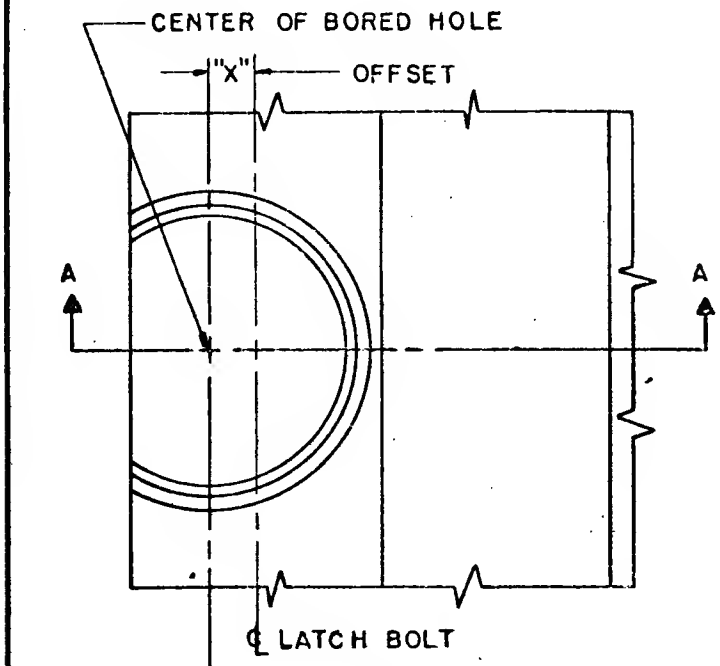
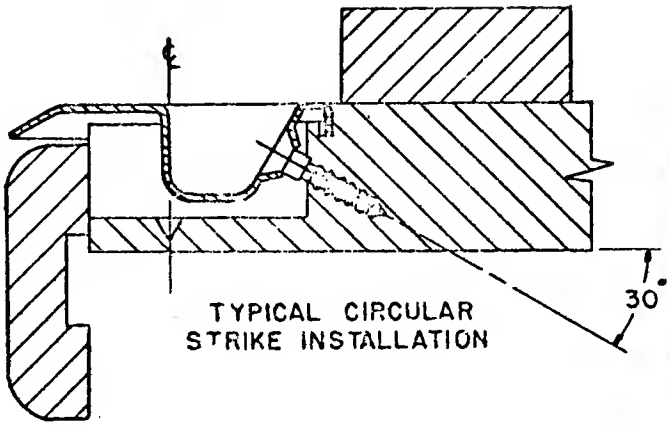


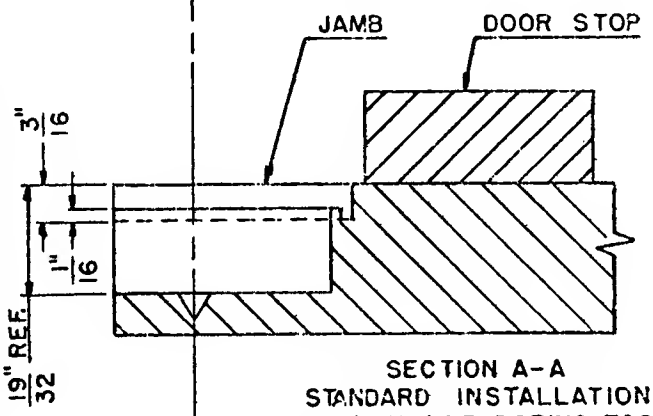
Exhibit B-2 "Door Kick Test"



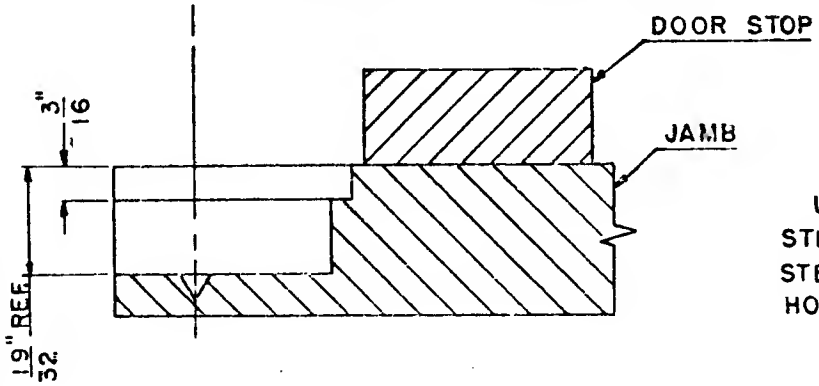
DIM. "X"	
1/4"	"A" LOCK
13/64"	"F" LOCK



TYPICAL CIRCULAR STRIKE INSTALLATION



SECTION A-A
STANDARD INSTALLATION
USE SCHLAGE BORING TOOL 1194

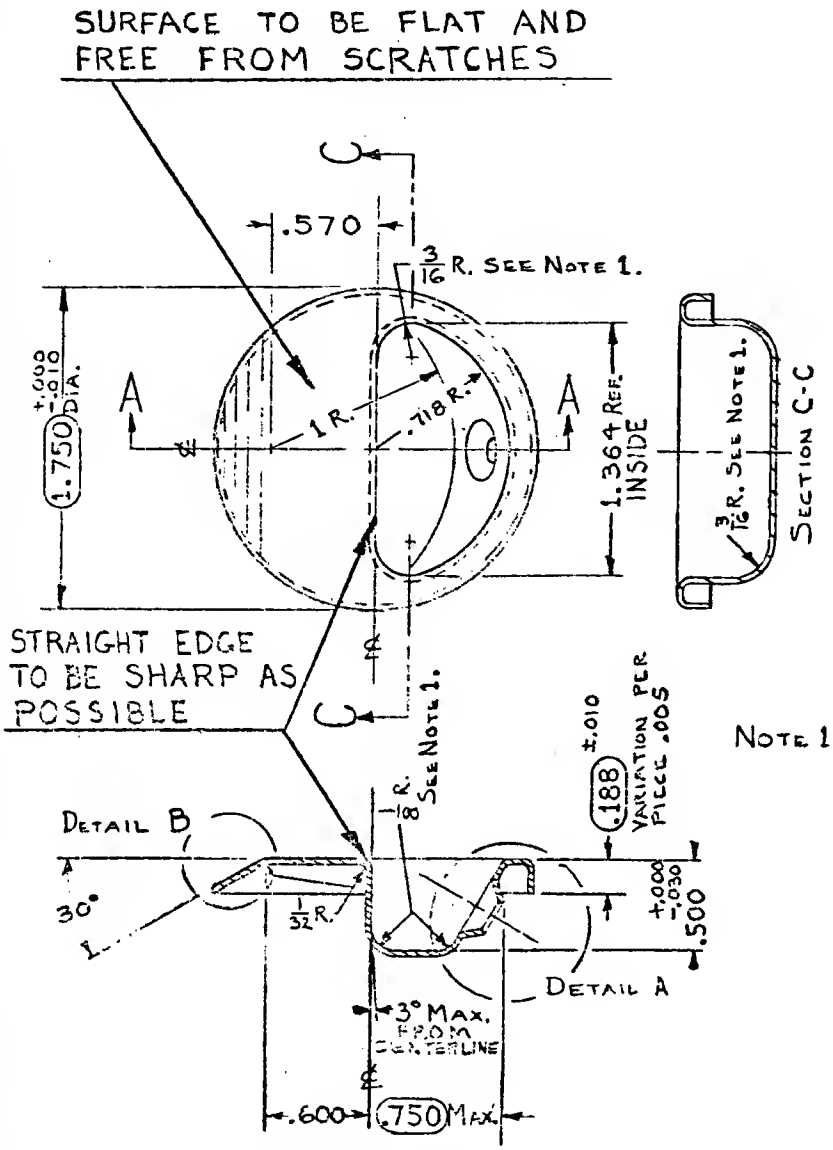


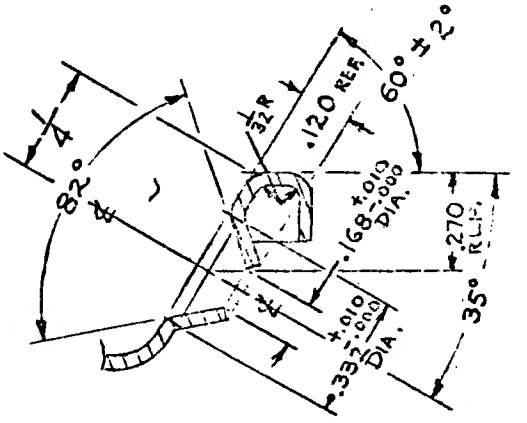
SECTION A-A
ALTERNATE INSTALLATION
USING CONVENTIONAL BORING TOOLS
STEP 1. DRILL 1 3/4" DIA. HOLE 3/16" DEEP
STEP 2. ON SAME ℄ DRILL 1 1/2" DIA. HOLE 19/32" DEEP

Exhibit B-3 "Installation Sheet"

THIS INSTALLATION SHEET IS FOR EXCLUSIVE USE ON JOB AS LISTED	JOB SERIAL NUMBER
JOB LOCATION	BACKSET DOOR THICKNESS WALL THICKNESS GAGE DECIMAL
SCHLAGE LOCK COMPANY	TITLE CIRCULAR STRIKE A & F LOCK INSTALLATION
	DATE INSTALLATION SHEET P-136 BY SCALE FULL

	ECL 114		924 CAT.	USAGE
			DWG.	

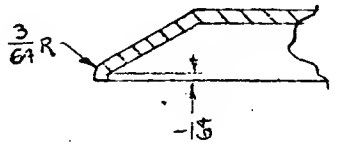




NOTE 1: 3/16 RADII TO BE BLENDED WITH 1/8 RADII.

Exhibit B-4

"Circular Strike Production Drawing"



.030 ±.0015 STNLSS STL TYPE 430

ISSUE SYMBOL	CHANGE AUTH. NO.	REVISION
	671640	OBSOLETE
C	660501	[illegible]
B	640007	STNLSS STL ADDED
A	631012	NEW ITEM

DRWN. BY	ORIG. DATE 5/20/63	MATL. .035 [illegible] BRASS, BRONZE	FINISH AS SPECIFIED	SCALE	SHEET 1 SHEETS 2
REDR. BY	REDR. DATE	UNSPECIFIED LIMITS DECIMALS ± .005 FRACTIONS ± 1/64 ANGLES ± 1/2° ECCENTY .004 T.I.R. GAGE CIRCLED DIMENSIONS	ABOVE DIMENSIONS APPLY BEFORE PLATING. IF PLATED, COATING SHALL BE .0003 ±.0001 ON EACH SURFACE. .010 R. ALLOWABLE AT COR'S AND INSIDE OF BENDS. BREAK SHARP EDGES.	TITLE STRIKE CIR	
CHKD. BY	APPR. BY			PRINT DATE	DWG NO. A.501-853
[illegible] LOCK & [illegible] COMPANY					

Dec. 1, 1964 E. L. SCHLAGE 3,159,416

CIRCULAR STRIKE

Filed Sept. 26, 1963 3 Sheets-Sheet 1

FIG_1

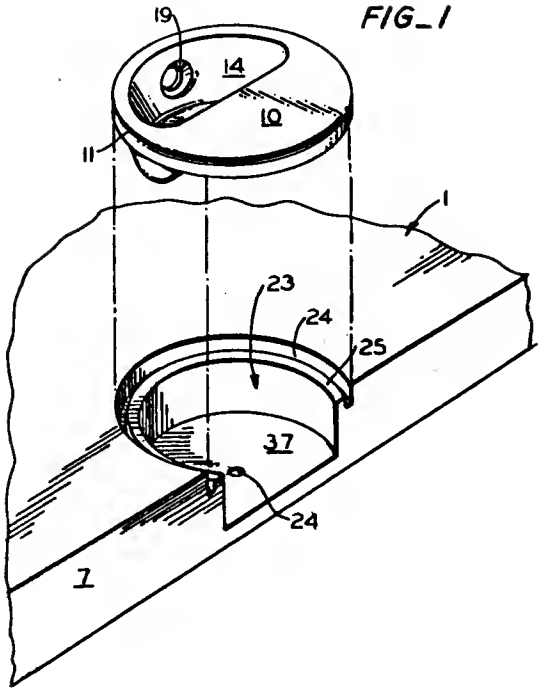


FIG_3

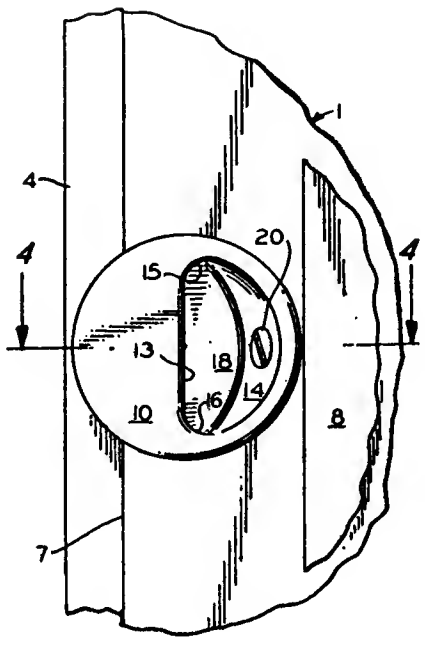


FIG_2

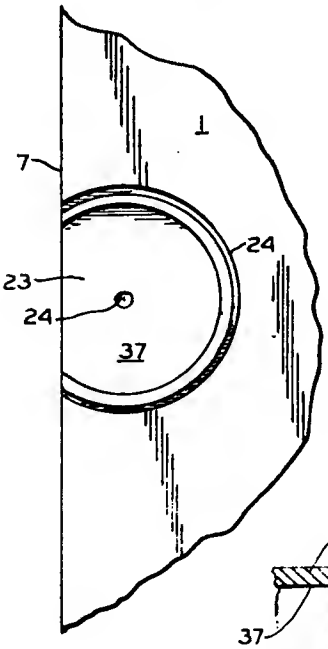


FIG_4

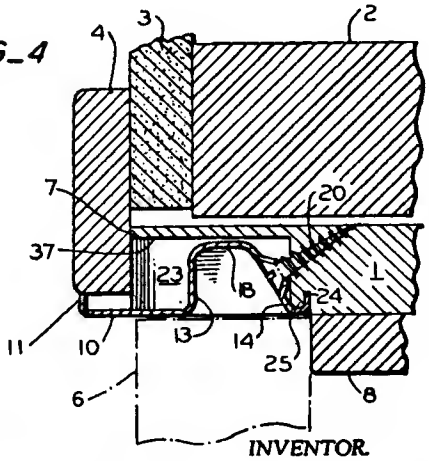
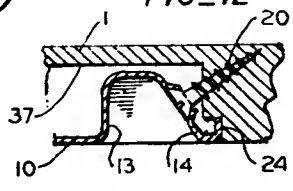


FIG_12



INVENTOR.
ERNEST L. SCHLAGE
BY
Gordon Wood
ATTORNEY

Exhibit B-5 "Excerpts from Schlage Patent 3,159,416"

United States Patent Office 3,159,416
Patented Dec. 1, 1964

3,159,416
CIRCULAR STRIKE
Ernest L. Schlage, Burlingame, Calif., assignor to Schlage Lock Company, a corporation
Filed Sept. 26, 1963, Ser. No. 311,815
17 Claims. (Cl. 292—340)

This invention relates to strike plates for door locks and more particularly to a strike having a substantially circular form.

The main object of the present invention is the provision of a strike which lends itself to installation into a bored circular opening formed on the door jamb so as to obviate much of the expense and time required in chiseling rectangular mortises and openings which heretofore have been necessary in the installation of the conventional strikes.

Another object of the invention is the provision of a strike that is substantially circular in shape and which is provided with means for rigidly securing it in a bored opening in the jamb, said means providing optimum resistance to its being pulled or torn out of the door jamb.

Another object of the invention is the provision of an improved circular strike of the type installed flush with the surface of the jamb.

Still another object of the invention is the provision of a strike and a method of installing the same which method lends itself to the use of power driving boring equipment suitable for prefabrication of door frames on which the strikes may be installed prior to shipping to a building site.

Yet another object of the invention is the provision of a strike having a latch bolt receiving opening which provides a maximum clearance in a vertical direction for the associated latch bolt thereby permitting larger installation tolerances and also allowing for vertical misalignment of the door and for door sag.

Yet another object of the invention is the provision of a circular strike which lends itself to rotation about the axis of the strike to permit the adjustment required to prevent door rattle in the event shrinkage results after the door has been installed.

Yet another object of the invention is the provision of a circular strike in which a strike box may be formed integrally therewith if desired.

Other objects and advantages will be apparent from the following specification and drawings wherein:

FIG. 1 is an exploded perspective showing one form of the invention in association with the recess formed in the jamb and adapted to receive the strike therein. The jamb is shown horizontally disposed as it may be during the door frame building operation.

FIG. 2 is a side elevation of a portion of a door jamb showing the recess adapted to receive the strike therein with the frame, casing molding and doorstop omitted.

FIG. 3 is a side elevation of a jamb including casing molding and doorstop showing the strike installed.

FIG. 4 is a horizontal cross section of the structure of FIG. 3 taken in a plane indicated by lines 4—4.

FIG. 5 is a front elevation of a modified strike adapted to receive two securing screws.

FIG. 6 is a side elevation of the strike of FIG. 5.

FIG. 7 is a side elevation of a boring tool adapted to form a recess that receives the flange formed on the strike.

FIG. 8 is a side elevation of the tool of FIG. 7.

FIG. 9 is a perspective of a modified form of strike provided with an inclined lip for engaging the latch bolt.

FIG. 10 is a perspective of a strike formed without a strike box.

FIG. 11 is a perspective of another modified form of strike.

FIG. 12 is a view similar to FIG. 4 but showing a modification of the recess that receives the strike.

FIG. 13 is a perspective of still another modified form of strike.

FIG. 14 is a cross section of the strike of FIG. 13 showing the same installed on a jamb.

FIG. 15 is a perspective of another modified form of strike.

In detail, and first with reference to FIGS. 3 and 4, the invention is adapted to be employed on the vertically extending jamb 1 which is generally secured to a rough framing member 2 adjoining a wall panel 3. Usually a length of casing molding 4 is secured by nails passing through the wall panel 3 to the frame 2.

In FIG. 4 the associated door 6 is indicated in dot-dash lines and the outer face of such door is generally coplanar with the outer edge 7 (FIG. 1) of the jamb. The inner face of door 6 is adapted to abut a stop 8 secured to the jamb 1.

It will be noted that the width of the jamb between the outer edge 7 and the stop 8 is available for installation of the strike and as will subsequently be understood the present invention makes optimum use of the relatively narrow space available, and which space is roughly equal to the width of the door.

One form of the strike of the present invention comprises a circular plate having a main planar portion 10 provided with an integral peripherally extending flange 11 which not only stiffens the plate but provides a means for enchancing the securement of the strike to the jamb in a manner that will subsequently be described. Integrally formed with the strike plate is a strike box having a relatively long, flat side 13 which extends diametrally of the plate and an opposite slantingly disposed side 14 which is connected to flat side 13 by curved junctures 15, 16 (FIG. 3). Said junctures and opposed sides are integrally connected to the bottom 18 of the strike box.

Centrally of the slanting side 14 there is provided a countersunk hole 19 for receiving therethrough a wood screw 20 for securing the strike to the jamb 1.

To obtain optimum resistance to the strike being pulled out of the jamb 1 the latter is formed in the manner shown in FIG. 1. A relatively deep clearance hole 23 is bored about an axis 24 (FIG. 2) for receiving the strike box therein. Radially outwardly of the central clearance hole 23 there is provided a circular groove 24 which is of a width to receive the flange 11 of the strike. Between the clearance hole 23 and the annular groove 24 an annular ridge 25 is provided the outer surface of which is spaced inwardly from the outer face of the jamb 1 a distance about equal to the thickness of the material forming the strike plate so that when the strike is installed the outer face of the planar portion 10 is coplanar with the outer face of the jamb 1.

Since the axis about which the hole 23 and groove 24 are formed is closer to the edge 7 than the radius of the clearance hole 23, it will be noted that both the hole 23 and the groove 24 break out of the edge 7 as best seen in FIG. 1. Referring to FIG. 4 it will be seen that when the strike is installed the molding 4 may be placed against the free edge of the overhanging flange 11 so as to close up the opening in the edge 7 caused by boring the above mentioned hole and groove.

The above operation is conveniently performed by means of a boring tool shown in FIGS. 7 and 8. To the arbor 30 of said tool there is secured by means of screws 31 a relatively flat blade 32 which is shaped and formed with cutting edges to provide a pair of cutting teeth 33 for forming the annular groove 24 and a lower cutting edge 35 for forming the clearance hole 23. Between the cutting teeth 33 and the central portion of the blade 32 cutting edges 34 are provided for forming the outer face

...etc.

The above specifically described preferred forms of the invention should not be taken as restrictive since it will be apaprent that various modifications in design may be resorted to without departing from the following claims.

I claim:

1. A strike for a door comprising:
a circular strike plate provided with a peripherally extending flange at right angles thereto,
a strike box formed integrally with said plate and having an open side for receiving a latch bolt therethrough,
said box being provided with one side adapted to be engaged by the corresponding face of a latch bolt positioned alongside said one side when such door is closed,
the side of said box opposite said one side being apertured to receive a securing screw therethrough.

2. A strike according to claim 1 wherein the portion of the annular juncture between said plate and said flange that is remote from said opposite side is formed with a slanting surface for engagement by the associated latch bolt when the door is closing.

3. A strike according to claim 1 wherein said one side extends diametrally of said plate to provide maximum clearance for such latch bolt.

4. A strike assembly for a door jamb comprising:
a circular strike plate including a strike box integral therewith received by said jamb,
said jamb being provided with a pair of coaxial bored holes,
the larger of said holes being relatively shallow and adapted to receive said plate therein and the smaller of said holes being relatively deep to receive said box therein,
said plate being provided with a peripherally extending flange substantially equal in width to the depth of said larger hole and adapted to be received in said larger hole.

5. In combination with a door jamb
a circular strike plate including a strike box integral therewith received on said jamb,
said plate being provided with a peripherally extending flange substantially at right angles to the plane of said plate,
said jamb being formed with an annular groove for receiving said flange therein and being formed with a central clearance hole concentric with said groove and inwardly thereof for receiving said box therein.

6. A strike assembly for a door comprising:
a door jamb,
a circular strike plate including a strike box integral therewith received on said jamb,
said plate being provided with a peripherally extending flange substantially at right angles to the plane of said plate,
said jamb being formed with a counterbore for receiving said flange therein and being formed with a central clearance hole concentric with said counterbore and inwardly thereof for receiving said box therein.

7. A strike assembly comprising:
a strike including an integral strike box,
a door jamb having a straight edge adjacent the outer face of an associated door in closed position,
a door stop on said jamb and spaced from said edge a distance substantially equal to the width of said door,
the face of said jamb between said edge and said stop being provided with a bored hole having a radius greater than the spacing between said edge and the center of said hole whereby said hole breaks out through said edge of said jamb,
said hole being of sufficient depth to receive said strike and box therein with the outer face of said strike substantially coplanar with said face of said jamb,
said strike being provided with a peripherally extending sidewall bottoming in said hole.

Claims 8 thru 16 have been deleted from this exhibit.

whereby said portions engage the side walls of said recess and resist outward movement of said plate in response to rebound forces impressed on said plate by said latch bolt.

17. A strike assembly adapted to cooperate with the latch bolt of an associated door comprising:
a door jamb having a vertically extending straight edge adjacent the outer face of such door in closed position,
a door stop on said jamb and spaced from said edge a distance substantially equal to the width of such door,
the face of said jamb between said edge and said stop being provided with a hole of sufficient depth to receive such latch bolt therein and having a radius greater than the spacing between said edge and the center of said hole whereby said hole breaks out through said edge of said jamb,
a substantially planar strike plate secured to said jamb,
said strike plate being formed with an arcuate peripheral portion having a center of curvature coincident with the center of said hole when said plate is so secured to said jamb,

said plate being provided with an aperture in registration with said hole for receiving such latch bolt therethrough,
the periphery of said aperture including a straight side extending parallel to said edge of said jamb and substantially through said center of curvature to permit optimum vertical clearance between said hole and the associated latch bolt, and
means integral with said plate at said aperture extending into said hole for receiving a fastener for securing said plate to said jamb.

References Cited by the Examiner

UNITED STATES PATENTS

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1,001,082	8/11	Samuelson	292—340
2,272,241	2/42	Fendring	292—340
2,401,854	6/46	Berry	292—341.9
2,861,660	11/58	Ensign	70—99 X
2,937,898	5/60	Russell	292—340
2,964,346	12/60	Check	292—340

ALBERT H. KAMPE, *Primary Examiner.*

DEVELOPMENT OF A CIRCULAR STRIKE PLATE AT THE SCHLAGE LOCK COMPANY (C)

In August 1963, as the new Schlage strike was first being delivered to the waiting distributors, Schlage initiated two new research projects concerned with further development of the circular strike. The purpose of the first project was to develop an adjustable circular strike; the second would investigate the possibility of modifying the original circular strike to be molded of plastic. Both projects were envisioned as long range ones in comparison to the fairly rapid development of the first circular strike, which had responded to a more urgent customer demand.

Later field results showed that adjustability for door rattle would be desirable due to the problems experienced by some mills in correctly locating the bored hole, but Mr. Schlage had recognized this potential difficulty even before the marketing of the strike. "It would no longer be possible to adjust the strike by removing, relocating the hole, and refastening. True, the circular strike could be rotated slightly to provide some adjustment, but this made it look haphazardly installed. Also, only one edge of the latchbolt then contacts the strike, causing a twisting movement of the bolt which might shorten the life of the lock." While the title of this research project was "Circular Strike, Adjustable" it was hoped that the resulting design might be applied to the standard Schlage rectangular strikes as well. In recognition of this fact, the name of the project was changed in November to "Adjustable Strike."

Neil Clumpner, a research engineer who had done some of the detail work on the first circular strike (in fact, he had prepared the final production drawing) began sketching possible designs for both projects. He concentrated his design efforts on trying to devise a method of adjustability which could be produced economically. Many adjustable strikes had been designed in the past, by Schlage and others; in fact, a search located over twenty patents concerned with lateral adjustment of strikes (illustrations from several of these patents are shown in Exhibit C-1). However, few of these designs had ever been produced because of their high cost of manufacture; the cost criterion became even more important for the circular strike, because it was aimed at the pre-hung door manufacturers whose product was sold primarily to builders of inexpensive tract housing.

Mr. Clumpner worked about half-time on the two projects through mid-October, sketching over 40 possible strike designs. As he sketched the various possibilities, he presented them to Mr. Ralph Neary, a senior engineer under whom he was working. Mr. Neary then selected the best of these for Mr. Clumpner to prepare in more detail. When this had been done, Mr. Neary would present them at a weekly Research meeting which would then make its recommendations as to whether or not the design should proceed to the modeling stage. Exhibit C-2 shows the first five designs in the adjustable strike project which were carried to the detail drawing stage.

While several of Mr. Clumpner's designs were modeled, none of them proved to be acceptable. An engineer in the

testing group also submitted a few designs after carrying out tests on several earlier models. Mr. Vern Bartels, present Manager of the Research Division, later commented, "As a project proceeds through the stages of modeling and testing, engineers in these departments often come up with design ideas which they develop on their own." However, none of these designs were modeled.

After October, both projects began to stagnate. The plastic strike project was soon closed, even though several strikes were successfully modeled and had performed well in tests. Indications at that time were that plastics still did not have a quality image before the public; also, fire conditions might soften the strikes and allow doors to open, permitting a fire to spread more easily. Schlage may again pursue the development of an all plastic strike in the future, particularly when injection molding techniques for the heat resisting thermosetting plastics are more fully developed.

The adjustable strike project slowed down due to personnel problems. Mr. Clumpner left the Research Division in December; the project was reassigned in January 1964 to Dave LaField, a young engineer just hired by the company.

Mr. LaField decided very quickly that the only way to make an inexpensive adjustable strike would be by using bendable tabs. He began by sketching possible "tab" configurations for the standard rectangular strikes, then carried the same basic idea over to the circular strike. Several pages from his initial drawings are included as Exhibit C-3. After developing this proposal, Mr. LaField summarized his design considerations, in which he emphasized the importance of an adjustment which the homeowner could recognize (several years after installation) and perform with simple tools (hammer and screwdriver) without removing the strike. He also felt that an adjustable strike should not have separate parts which could be lost.

Due to a personality conflict with the then Research Manager, Mr. LaField left the Research Division in late January and his proposal was not modeled. Several of the other engineers felt that his design had definite shortcomings. Since the tab was of heavier material than the strike body, it was felt that the body of the strike would be deformed during attempts at adjustment. It also appeared unlikely that the homeowner could achieve all of the configurations suggested, and the cost would certainly be quite high, as a new die would be required for the strike body, due to the enlarged strike box.

Nothing more was done on the project until April, when field reports began to realize Mr. Schlage's premonitions concerning adjustability. Mr. Schlage began to think about the adjustability problem himself and soon came up with the idea of simply punching 2 slots in the bolt receiving face of the present circular strike, as shown in Exhibit C-4, to permit some adjustment for door rattle. Also shown is a sketch of a possible punching tool. It took only 5 hours to model this design; during May, extensive tests were carried out to measure its strength and adjustability. Discussion and results of the tests are included as Exhibit C-5. Mr. Schlage later commented on this design. "It appeared that this modification would solve some adjustability problems, particularly door rattle. While the production people first said they could not cut the slots, Jim Maher in our model shop built a tool which cut them very nicely, so that we foresaw a

very small additional production expense for adjustability. One drawback brought out by the tests was that door slams could change the adjustment, but this would be a problem with any scheme involving bending metal. Any piece adjusted by prying with a screwdriver will deform under a slam."

After results of the tests were considered, the Research Department decided to release the modified strike for production. However, the then General Manager of the company, Mr. Levinger, vetoed the modification on the grounds that field demand wasn't yet strong enough and the cost was too great; he felt that adjustment by rotation was adequate. The project was then closed.

In February 1965 the Product Committee, composed of the General Manager and leaders from sales and all 3 engineering groups, recommended that Mr. Schlage's "bulge-type" (slotted) adjustment feature be improved for marketing; a new research project was set up, entitled "Circular Strike, Adjustable." Several variations of the slotted arrangement were tried, but the pilot run of 5,000, produced in early May, was essentially identical to the first design. The project was placed on inactive status for six months to allow time for evaluation in the field.

In the November Product Committee Meeting, the Sales Manager presented a summary of customer reaction to the modified strike; the general conclusion was that, while it was an improvement over the original circular strike, the customer would prefer adjustment in 2 directions (for both door rattle and failure to latch, rather than just the former). The sales manager also noted that the slotted strike did nothing to prevent the strike lip from tilting up as a result of improper fastening screw angle. As a result of these considerations, the slotted strike did not go into production, and the adjustable strike project suffered another slow-down. Mr. Schlage later commented, "At that point we appeared to be at an impasse. The general manager of the company had already expressed his view that even the slotted adjustability feature would be too expensive; yet now he could not understand why we had not developed a "better" solution. He now requested the Research and the Product Design engineering divisions to develop completely new design strikes from an entirely new aspect which would remedy the problems encountered with the original circular strike." The requirements of this new strike can be summarized as follows:

1. Retain the single bored hole installation, large sag allowance, pleasing appearance, low cost and adequate strength.
2. Provide a bolt holding surface in the strike which can be adjusted to permit latching without rattle.
3. The bolt holding surface must be easily adjusted in the field and must retain its position even after moderate door slams.
4. Overcome the occasional problem of the latchbolt contacting the wood molding before the metal strike plate during closing of the door.
5. Overcome the tendency of the strike plate to lift out of its recess in the jamb upon tightening of an improperly directed fastening screw.

Note: Part D of ECL 114 describes the work culminating in the development and adoption of the adjustable circular strike which satisfied all the above-mentioned requirements.

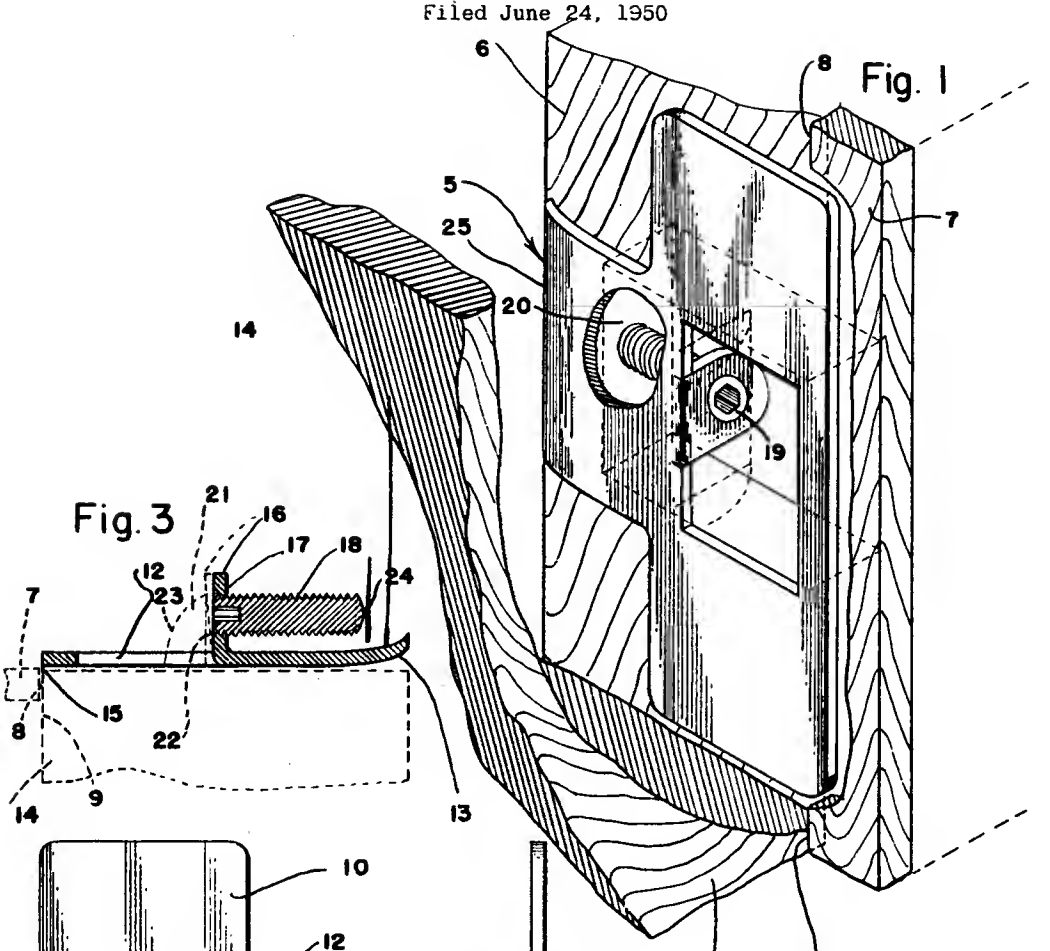
ibits, Section C

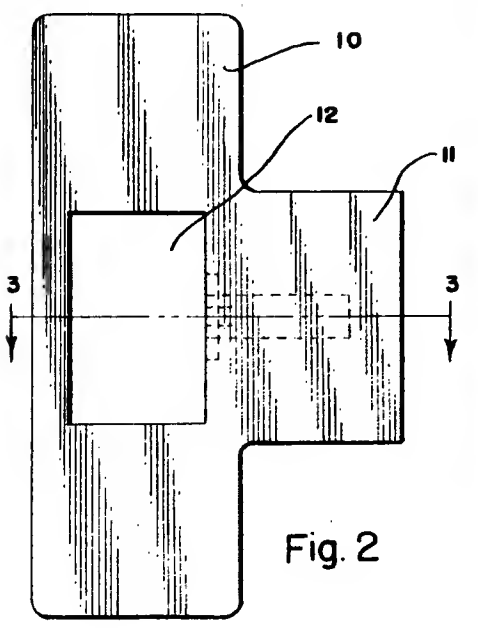
Exhibit C-1	"Patented Adjustable Strikes" (3 pages) (drawings from patents 2,650,848, 2,790,667, and 3,006,677)
Exhibit C-2	"Five Concepts for Adjustable Strike"
Exhibit C-3	"Lafield's Bent-Tab Adjustable Strike" (consists of 4 drawings)
Exhibit C-4	"Slotted Strike Concept"
Exhibit C-5	"Excerpts from Test Report on Slotted Strike"

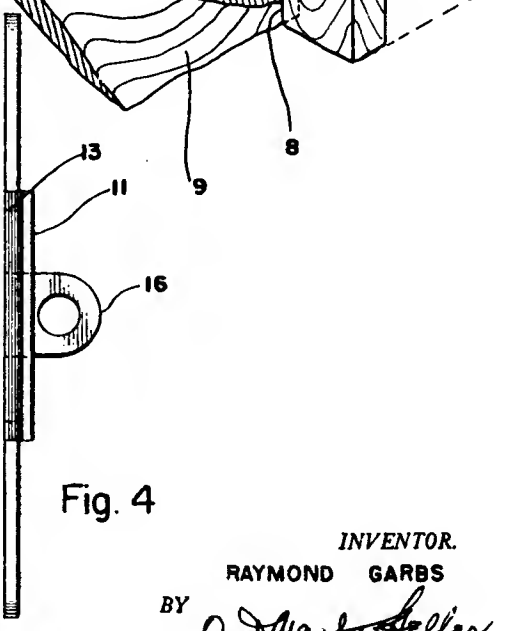
Sept. 1, 1953 R. GARBS 2,650,848

STRIKE PLATE

Filed June 24, 1950







INVENTOR.
RAYMOND GARBS
BY
ATTORNEY

Exhibit C-1

"Patented Adjustable Strikes"

April 30, 1957 A. SCHOEPE 2,790,667

ADJUSTABLE STRIKE

Filed Feb. 8, 1954 2 Sheets-Sheet 2

FIG. 7.

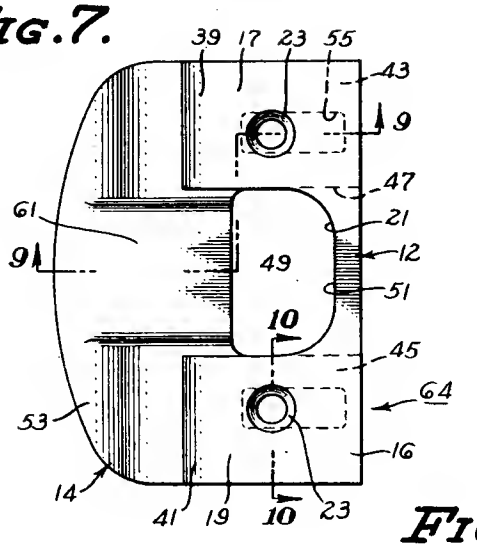


FIG. 8.

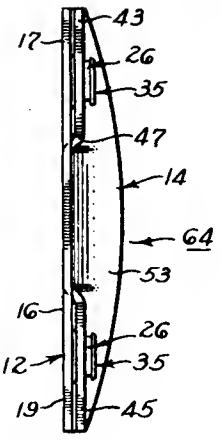
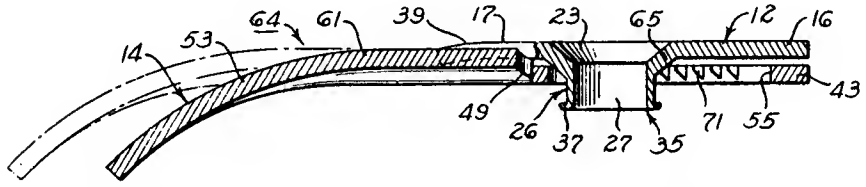
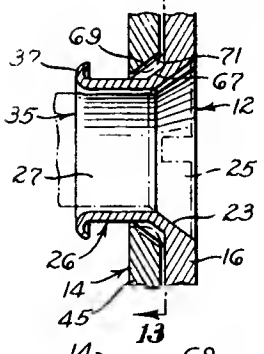


FIG. 9.



13 FIG. 10.



12 FIG. 11.

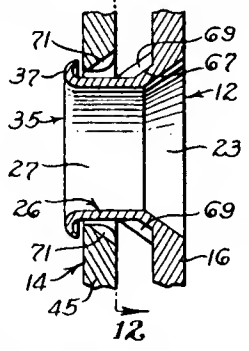


FIG. 12.

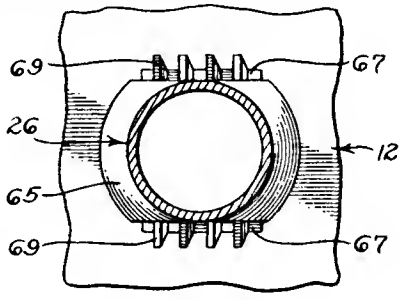
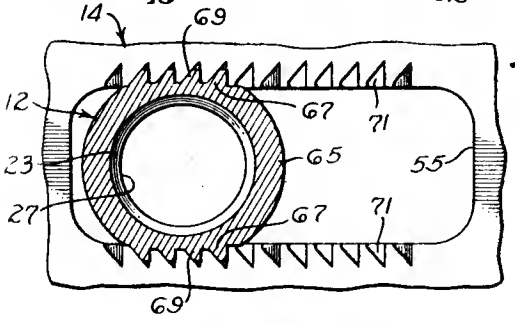


FIG. 13.



INVENTOR.
ADOLF SCHOEPE
BY Thomas P. Mahoney
ATTORNEY.

Exhibit C-1 "Patented Adjustable Strikes"

ECL 114

Pat. File #
Gen. Int. ✓
Inv. Subm.
Ref. of Pat.
Search #
Project 6501
Other ADJUSTABLE STRIKE

Oct. 31, 1961 J. ROYALTY 3,006,677

ADJUSTABLE STRIKE PLATES

Filed Nov. 27, 1959

Fig. 2.

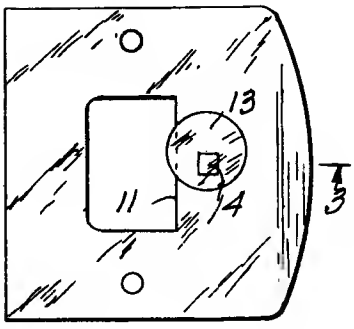


Fig. 1.

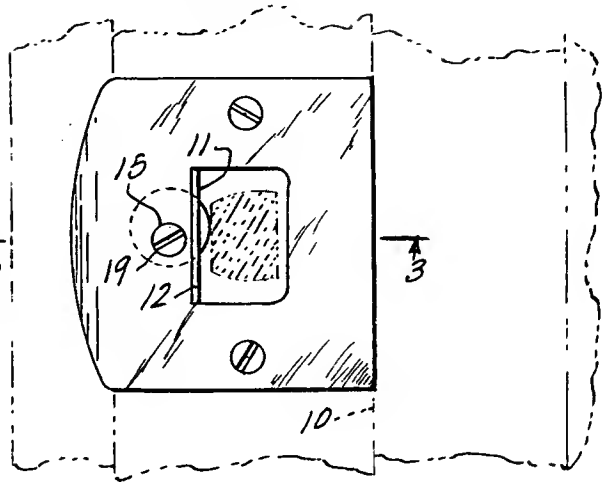


Fig. 3.

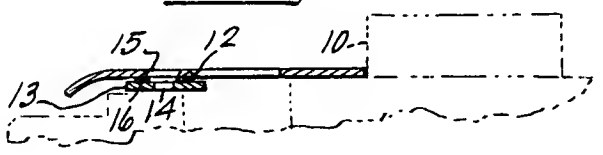


Fig. 5.

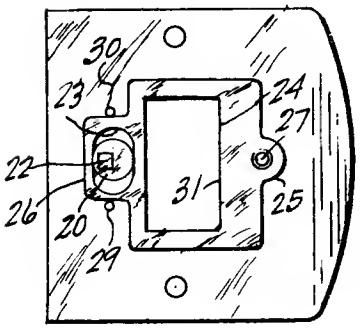
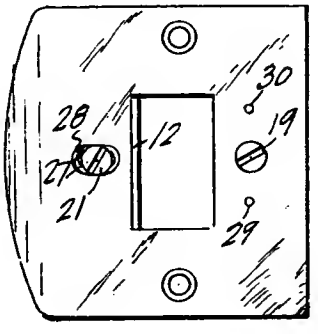


Fig. 4.



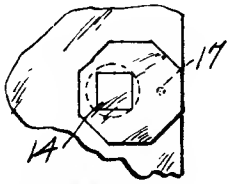


Fig. 6.

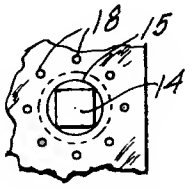


Fig. 7.

INVENTOR.
John Royalty
BY Philip A. Smidell
Attorney

(page 3 of 3)

Exhibit C-1 "Patented Adjustable Strikes"

SCHLAGE LOCK COMPANY RESEARCH DIVISION	RESEARCH PROJECT: Cylindrical Strike, Adjustable	RP6308	SH. 1
		DATE: 8-1-63	OF ....

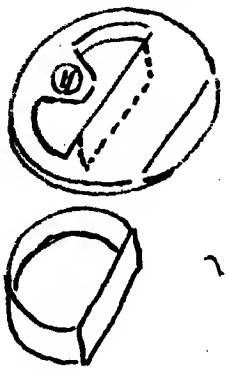
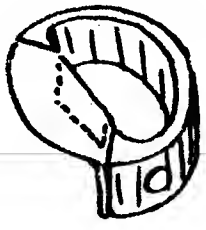
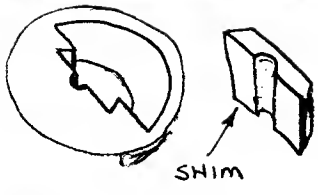
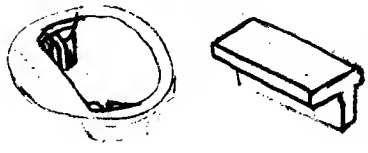
DESIGN NO.	DATE	DESCRIPTION (SKETCH)	RS. NO.	NO. OF MODELS	RT. NO.	PAT. FILE	REMARKS (CONCLUSIONS)	INIT.
		Note: Early sketches or copies of sketches of adjustable strikes are included in this file. These sketches are dated 1950, 1953, 1959 and 1960.						
1.	8/13/63			1.	145		Two pieces. Strike had no strike box, box was second piece. strike had adjustable lip.	NC
2.	8/16/63		0362 0361 0360 0363		146		Two pieces. Strike lip was movable within strike body	NC
3.	10/7/63		0383 0385 0384	1	163		Two pieces Strike lip. Metal with bendable adjustment tab. Strike body. Plastic. with and without sarrated perimeter.	NC
* 4	7/26/63		SKETCH N.C.				PLASTIC, OR CAST METAL	
* 5	7/29/63		SKETCH N.C.				PLASTIC OR CAST METAL.	

Exhibit C-2

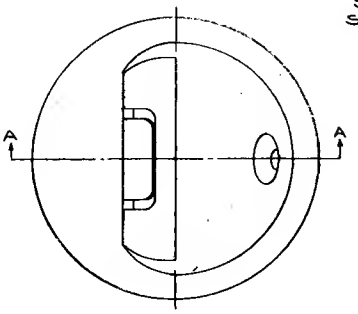
"Five Concepts for Adjustable Strike"

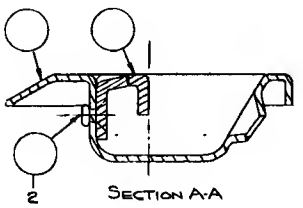
* INDICATES PAGES OF FILE TRANSFERRED TO RP 6501

SCHLAGE LOCK COMPANY | ENGINEERING COMPUTATION AND SKETCH SHEET | MODEL | PART NO. | SERIAL NO. RP6308 | NAME CIR. STRIKE, A&F-ADJUST.

3 WAY ADJUSTABLE CIRCULAR STRIKE

SKETCH 3
SHEET 1 OF 4





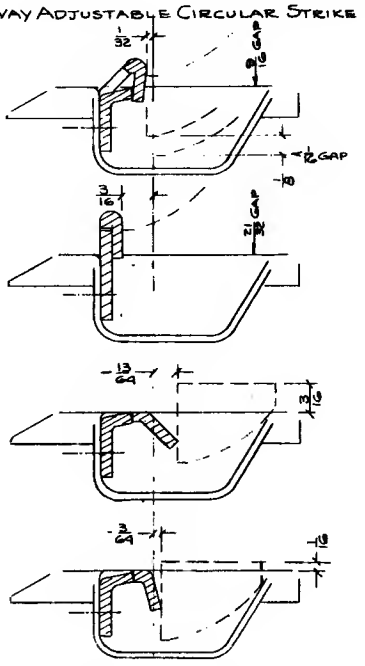
SECTION A-A

SCALE 2-1

FOR DEPT	SKETCHED BY	COMPUTED BY	CHECKED BY	APPROVED BY	FINAL APPROVAL
	DR LAF				
	DATE 1-9-64	DATE	DATE	DATE	DATE

SCHLAGE LOCK COMPANY | ENGINEERING COMPUTATION AND SKETCH SHEET | MODEL | PART NO. | SERIAL NO. RP6308 | NAME CIR. STRIKE - A&F - ADJUST.

3 WAY ADJUSTABLE CIRCULAR STRIKE

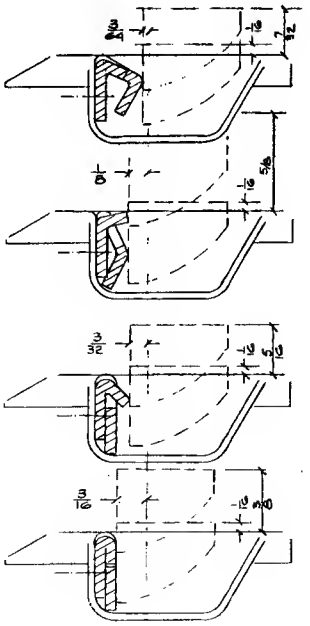


SCALE 2-1

FOR DEPT	SKETCHED BY	COMPUTED BY	CHECKED BY	APPROVED BY	FINAL APPROVAL
	D.R. LAF				
	DATE 1-9-64	DATE	DATE	DATE	DATE

SCHLAGE LOCK COMPANY | ENGINEERING COMPUTATION AND SKETCH SHEET | MODEL | PART NO. | SERIAL NO. RP 6308 | NAME CIR. STRIKE, A&F, ADJUST.

3 WAY ADJUSTABLE CIRCULAR STRIKE



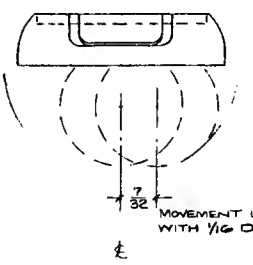
SCALE 2-1

1/2" BOLT EXTENSION

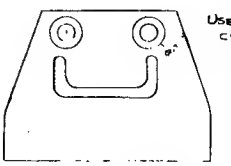
FOR DEPT	SKETCHED BY	COMPUTED BY	CHECKED BY	APPROVED BY	FINAL APPROVAL
	DR LAF				
	DATE 1-9-64	DATE	DATE	DATE	DATE

SCHLAGE LOCK COMPANY | ENGINEERING COMPUTATION AND SKETCH SHEET | MODEL | PART NO. | SERIAL NO. RP6308 | NAME CIR. STRIKE, A&F, ADJ.

3 WAY ADJUSTABLE CIRCULAR STRIKE



MOVEMENT UP OR DOWN WITH 1/16 DOOR GAP



USE TWO 3/32 RIVITS C'SUNK HEADS

MAT'L .064 BRASS

FOR SIDE VIEW, SEE SKETCH 1

SCALE 2:1

FOR DEPT	SKETCHED BY	COMPUTED BY	CHECKED BY	APPROVED BY	FINAL APPROVAL
	DR LAF				
	DATE 1-9-64	DATE	DATE	DATE	DATE

Exhibit C-3 "Lafield's Bent-Tab Adjustable Strike"

SCHLAGE LOCK COMPANY

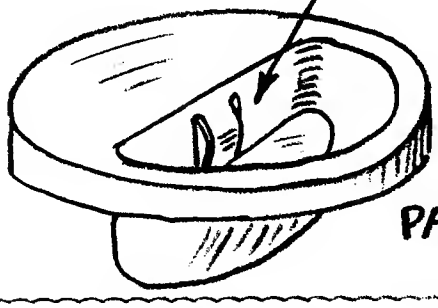
EN NEERING COMPUTATION AND SKETCH SHEET
FORM 391

MODEL \RT).

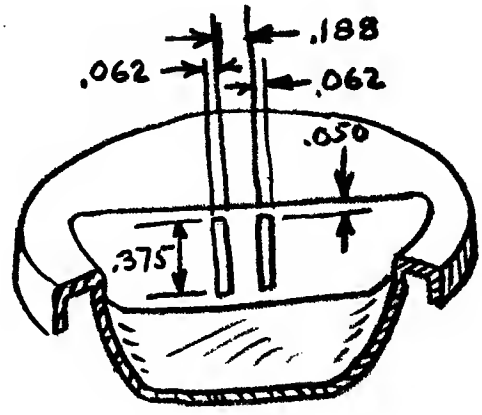
SERIAL NO.

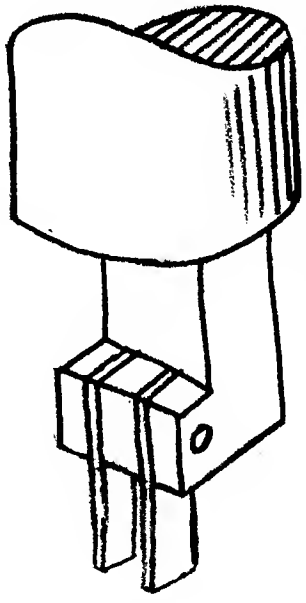
NAME PATENT FILE 391

Bridge bowed outwardly by screwdriver when necessary to adjust strike for door rattle.

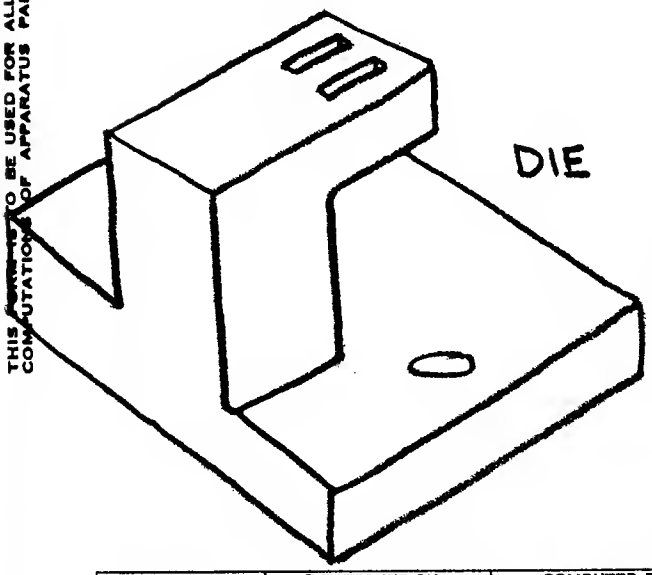


PART





PUNCH



DIE

ADJUSTMENT FOR CIRCULAR STRIKE

ADVANTAGES

1. No additional parts.
2. Simple punch press operation.
3. Only screwdriver required for adjustment.
4. Not necessary to remove strike from jamb to make adjustment.
5. Strike only slightly weakened by slots.
6. Appearance of strike not diminished by narrow slots.
7. Bowed out bridge resists door slamming forces.
8. Perhaps this operation could be combined with screw countersink operation in a dial press.

THIS FORM MUST BE DATED AND FILED FOR REFERENCE

THIS FORM TO BE USED FOR ALL SKETCHES AND COMPUTATIONS OF APPARATUS PARTS AND TOOLS

FOR DEPT	SKETCHED BY	COMPUTED BY	CHECKED BY	APPROVED BY	FINAL APPROVAL	SERIAL NO.	PART NO.
	E L Schlage						
	DATE April 22, 1964	DATE					

Exhibit C-4 "Slotted Strike Concept"

SCHLAGE LOCK COMPANY
RESEARCH DIVISION

TEST REPORT

RT 196
6-4-64 PAGE 3

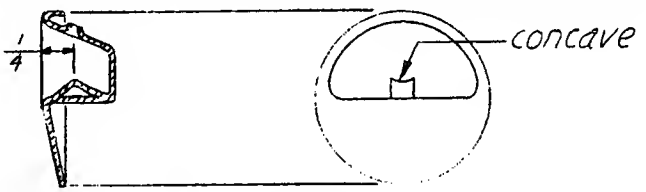
Discussion:

Although it was possible to obtain .110" adjustment, in another case the adjustment bridge cracked and failed at .085". To prevent this cracking the maximum allowable adjustment should be 5/64". There was no difficulty in inserting a flat screwdriver blade and rotating it to obtain the desired adjustment. Of course, reasonable care must be exercised or the strike can be pried out of the door jamb or the bridge can be ripped by the screwdriver blade.

If the adjustment is made at the strike installation, a Phillips screwdriver is used for installation and a flat blade screwdriver for adjustment. This should not be objectionable.

Both light and medium slams depressed the adjustment bridge but the test door was 1¾" x 32" solid core. As a measure of slam severity, on RT 126 a medium slam of this size and weight door cracked the door jamb. Of course, the condition of the jamb, such as wood grain, is also a factor.

The peak of the bridge is approximately ¼" from the strike surface and rotating the screwdriver gives this shape to the bridge:



This means that with a ⅛" or larger door gap and using a ⅜" throw latch unit the tip of the bolt will rest short of or at the bridge peak. In the warped door test the tension against the flat of the latch bolt caused the bolt to retract and the door to open. This same condition would exist on any strike with bendable tab except the tab surface would not be concave so the bolt would be contacting the tab over a larger surface.

Conclusion:

The adjustable circular strike will adjust to a maximum 5/64" and will probably prove most satisfactory on hollow core inside doors.

Reasonable care must be exercised when making the adjustment to prevent prying the strike out of the jamb or ripping the adjustment bridge with the screwdriver blade.

A badly warped door might not stay latched if the maximum adjustment was made in the strike. Tension against the flat of the latchbolt resting on an oblique surface might cause the bolt to retract itself. The maximum adjustment and warping would not exist together initially but if a maximum adjustment has been made for rattle, the door can warp later. Then the two conditions would exist together.

The adjustable bridge can be reset several times without metal failure.

Howard Scheffel
Howard Scheffel

Exhibit C-5 "Excerpts from Test Report on Slotted Strike"

DEVELOPMENT OF A CIRCULAR STRIKE PLATE AT THE SCHLAGE LOCK COMPANY (D)

In the first quarter of 1966, both research and product design worked on separate versions of an adjustable circular strike. As the weeks went by, the general manager grew more and more impatient for a solution to the problem. During this time the Research Department came up with a scheme for adjustability involving a movable slide to contact the latchbolt. Earlier versions of this idea had apparently been conceived by engineers in the model shop; the U-shaped metal slide arrangement sketched in Exhibit D-1 was designed by the Research Department Manager. A model of a movable slide was made which was presented to the Product Committee in March. This model was installed with 2 screws to overcome the tilt-up problem.

Management response to the model was mixed. In general they thought it was the best solution yet presented, but they were worried about the cost. Research was told not to exhibit the strike to sales until production estimates were available. However, on the basis of this model, the project was tentatively reassigned to Research and the strike was further developed. On the basis of door slam tests, serrations were added between the slide and strike body to prevent slipping of the slide (Exhibit D-2).

One of the Schlage's largest customers was having particular difficulty with the circular strikes; they had used several thousand slotted strikes but still were not completely satisfied and threatened to change to a competitive brand of hardware. In June Mr. Schlage made a trip East to attempt to pacify this customer; on seeing the serrated-slide adjustable strike, the customer's people were most impressed and stated they would continue to handle the Schlage line if this strike were made available to them as soon as possible. At Product Committee meetings during Mr. Schlage's absence, however, the general manager summarized his views on the adjustable strike, stating that he felt no "simple and economical" solution had been presented to management; he advocated purchasing rights to a competitive strike very similar to that shown in the Russell patent (Exhibit A-7) but with a bendable tab to engage the latch bolt for adjustment. Since their strike had no integral strike box, it could be made of heavier metal; thus the tab was less apt to bend (changing the adjustment) under a heavy slam.

When Mr. Schlage returned and learned of the impending negotiations over the competitive strike, he communicated with the general manager and convinced him that such negotiations were unnecessary, as Schlage should retain the large allowance for door sag; if this were done, they need not fear infringement. Before a decision was made between a simple bent-tab scheme and the serrated slide, the product design group submitted their version of the adjustable circular strike. This model, shown at the left in Exhibit D-3a, was made of thicker material (.050") and had no strike box. It fit into a deeper hole bored to a single diameter, and had a bendable tab for adjustment. Indications were that this strike could be produced for only slightly more than the original circular strike; the Product

Committee decided to see how this strike would be received by the same customer recently visited by Mr. Schlage. The customer did find this new version acceptable, and Product Design was authorized to complete development of the strike and order tooling for a pilot run as soon as the drawings were finalized. The project was scheduled for completion in February 1967. Meanwhile, the Research strike was put on a six months inactive status. A month later, however, management had a change of heart, and the serrated-slide strike was given first priority.

With the project now back at the drawing boards of the Research Division, it was still to be 9 months before the final "freezing" of the design. During this time, a major choice was made between the integral-strike box design (Exhibit D-3b) and a compromise strike which was quickly modeled by the Research Division and was essentially the Product Design version but with the substitution of a plastic slider for the bendable tab (Exhibit D-3a right). The former version was chosen for several reasons; for one, the immediate demands of the customers could be most quickly satisfied by producing an interim strike which would be made from a non-adjustable circular strike reworked to include a movable slide. The expensive non-adjustable strike dies could be used to perform the first manufacturing step. The main reason, however, was probably the higher quality appearance of the integral strike box version.

Decisions on details of the strike were being made both before and after the major choice concerning the integral strike box. Many months were spent on selection of the slider material; after a great deal of pricing and testing, black delrin was chosen. This plastic performed very well in the tests, and would give a slight reduction in contact noise as compared to metal. Design and testing time was also spent determining the best location for the 2 fastening screws. This work was completed before the pilot run was started in February. Many design modifications were made to the strike body before the freezing of the final production model in June 1967; these included an enlarging of the strike box and the addition of a short lip (the strike would no longer be completely circular) to prevent the latchbolt from striking the wood trim strip before the strike. The drawing of the strike body and the slider are included as Exhibit D-4.

An evaluation of the pilot run indicated the adjustable circular strike would be a very popular item. After completion of the design in July 1967, work began on the production dies, including a new 14 station progressive die for the strike body. The plastic slides were being purchased from a vendor. As individual punch and die sets were completed, sample parts were made from them and checked against the specifications. If some dimensions were outside the tolerances, either the dies or the drawings had to be modified, depending on the location and seriousness of the misfit. Tooling for production was a long, slow process; in August of 1968, the main die was just being completed; full production was scheduled to begin in late 1968. A second patent application was filed covering the improvements made to the circular strike.

On looking back over the project, Mr. Schlage commented, "To most of my non-engineer colleagues, the amount of time, effort, talent and knowledge required to develop such an apparently simple piece of bent metal was greatly underestimated.

Actually many disciplines were involved in its design. First, there was a familiarity with the product line, its performance in the field and its relationship with competitive lines. Salesmen's reports and customers' letters were analyzed to obtain knowledge of changing conditions in the field which required product modifications or new items. The ability to invent and solve problems was present as well as a thorough understanding of issued patents relating to the product. The engineer took into account the capabilities of the production machinery and processes in his factory and knew from experience and training the physical properties of the materials which he selected for the product. Accurate drafting was prerequisite to the graphical determination of forces and the establishment of dimensions, clearances and tolerances necessary for interchangeable manufacture. An acquaintance with labor, material and overhead costs as well as amortization of equipment and tooling costs was necessary when preparing product proposals. Also required was a familiarity with testing, aesthetics or industrial design, standards, purchasing practice and field surveys. Finally, since the engineer is a member of a team, he had to demonstrate the ability to communicate, cooperate and get along well with others in his company.

The delays, misunderstandings, failures, obstacles, frustrations and the duplication of effort in other departments were taken philosophically, and who knows but what they contributed in some mysterious way to the ultimate success of the final product.

An unexpected benefit emerged from this project which promises to be very profitable for the company. The strike plate furnished with the vast majority of locks has the conventional Tee-shape and is stamped from heavy gage brass. The strike box is a separate piece of zinc dichromated steel intricately folded by a multi-slide machine. This project has now taught us how to make this Tee strike of thin sheet brass. Sufficient strength is obtained by drawing down a peripheral skirt and incorporating an integral drawn strike box as was done on the circular strike. The savings in material costs are substantial and would even pay for the addition of the adjustable slide if desired."

Exhibits, Section D

Exhibit D-1	"Movable Slide Concept" (sketch)
Exhibit D-2	"First Serrated Slide Concept" (2 sheets)
Exhibit D-3a	"Product Design Strike & Compromise Strike" (photograph)
Exhibit D-3b	"Pilot Run Sample of Movable Slide Strike" (sketch & photograph)
Exhibit D-4	"Final Design"

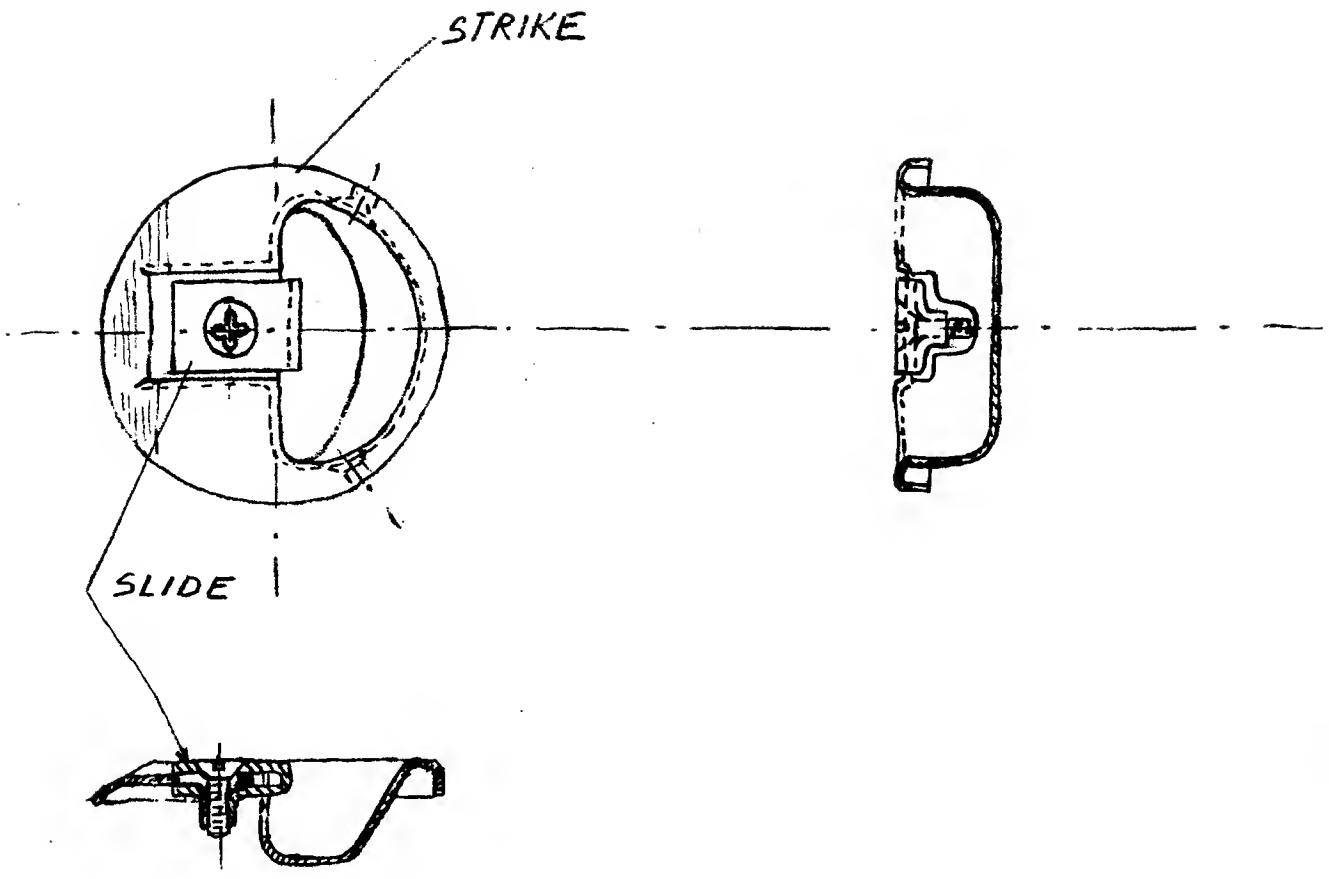


Exhibit D-1

"Movable Slide Concept"

2-21-66 L.

RP 6501

1:1

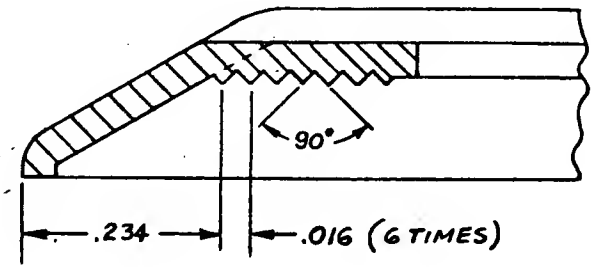
CIRCULAR STRIKE
ADJUSTABLE

RS-1262

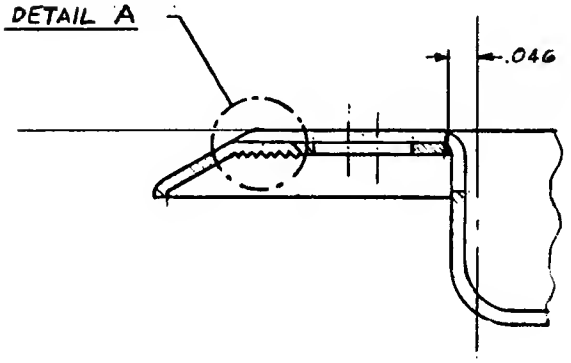
SCHLAGE LOCK COMPANY	ENGINEERING COMPUTATION AND SKETCH SHEET FORM 999	MODEL	PART NO. RS-1279
			SERIAL NO. RP 6501
			NAME CIRCULAR STRIKE, ADJUST.

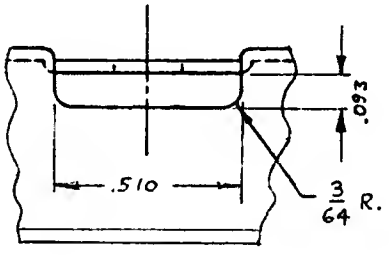
Exhibit D-2

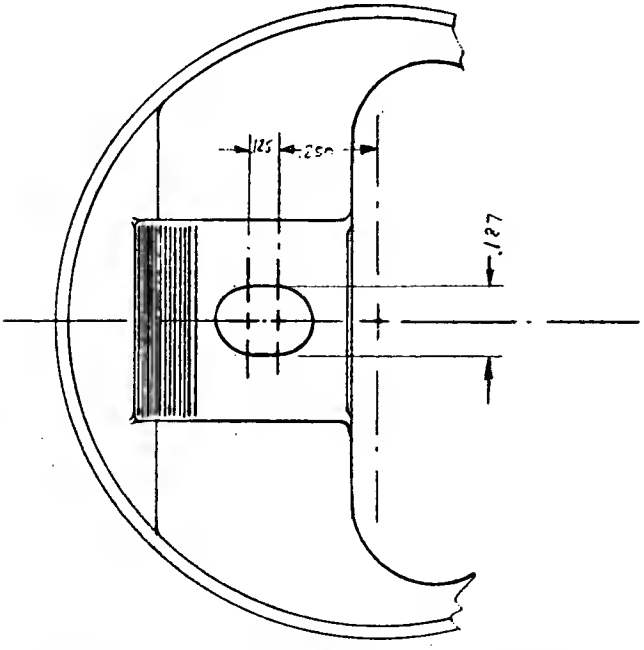
"First Serrated Slide Concept"



DETAIL A
SCALE 5:1





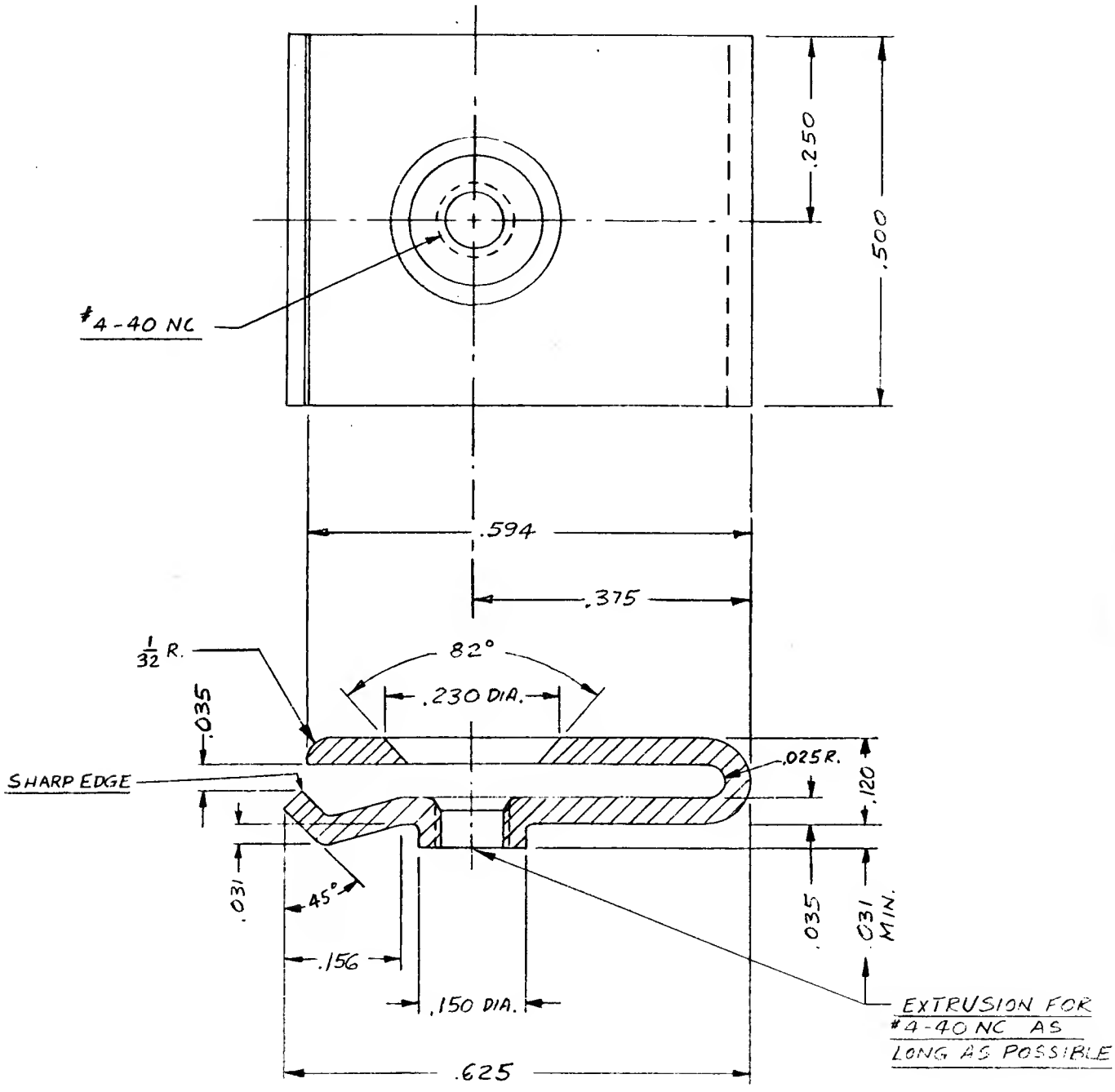


FOR LICENSEE USE ONLY

SCALE 2:1, 5:1

FOR DEPT	SKETCHED BY	COMPUTED BY	CHECKED BY	APPROVED BY	FINAL APPROVAL	SERIAL NO.	PART NO.
	HKG						
	DATE 3-16-66	DATE	DATE	DATE	DATE		

SCHLAGE LOCK COMPANY	ENGINEERING COMPUTATION AND SKETCH SHEET FORM 356	MODEL	PART NO. RS-1278
			SERIAL NO. RP.6501
			NAME SLICE



SCALE 5:1

MATERIAL: .035 BRASS

Exhibit D-2 "First Serrated Slide Concept" (page 2 of 2)

FOR DEP'T	SKETCHED BY	COMPUTED BY	CHECKED BY	APPROVED BY	FINAL APPROVAL
	HKG				
	DATE 3-16-66	DATE	DATE	DATE	DATE

SERIAL NO. RP.6501 PART NO. RS-1278

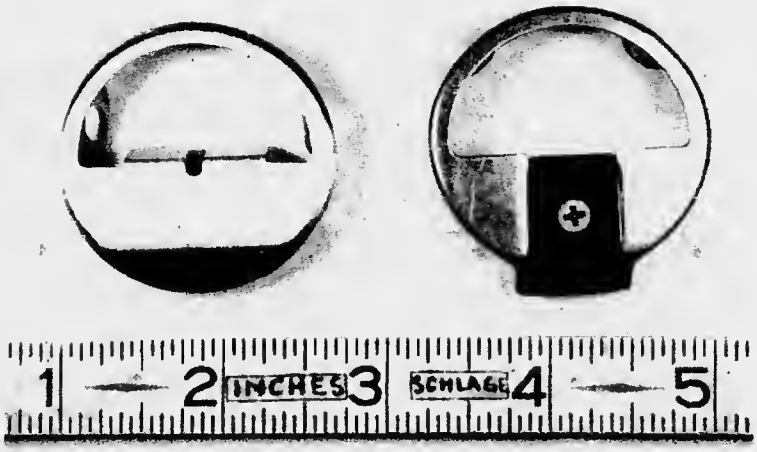


Exhibit D-3a

"Pilot Run Sample of Movable Slide Strike"

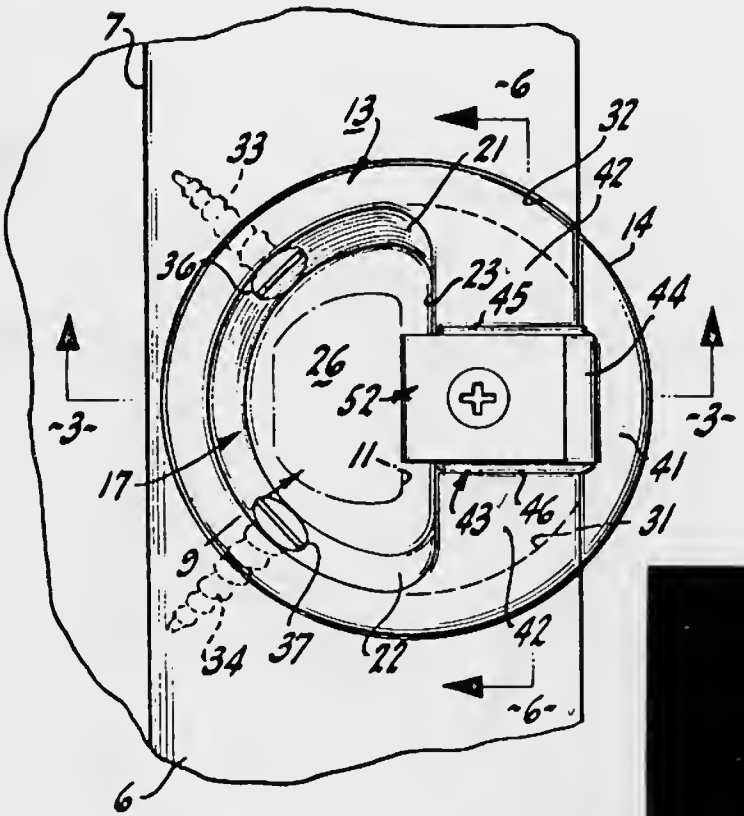
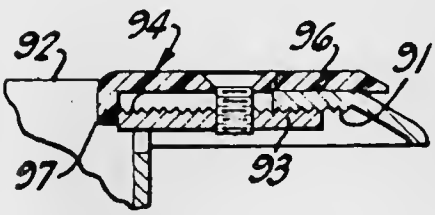


Exhibit D-3b

"Product Design Strike & Compromise Strike"



LIETZ NO. 1010

FORM NO. 1X3A

ECL 114	1112	CAT.	USAGE
		DWG.	

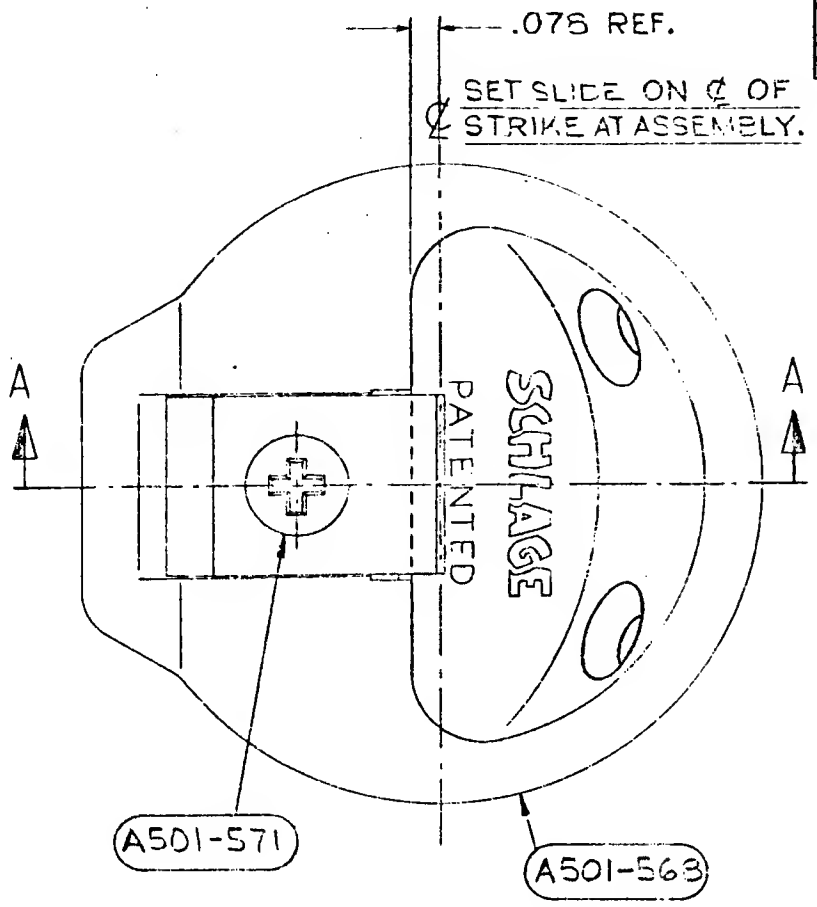
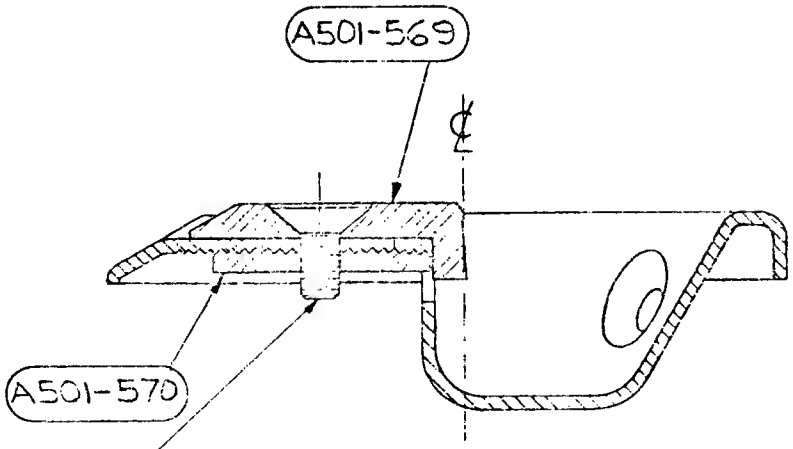


Exhibit D-4

"Final Design"



INTERRUPT ONE THREAD MAX. TO PREVENT REMOVAL OF SCREW.

BRASS
BRONZE

ISSUE SYMBOL	CHANGE AUTH. NO.	REVISION
△	37616	NEW ITEM

DRWN BY HKG	ORIG. DATE 3-27-97	MATL. AS REQUIRED	FINISH AS SPECIFIED	SCALE 2:1	SHEET 1	SHEETS 1
REDR. BY	REDR. DATE	UNSPECIFIED LIMITS DECIMALS ± .005 FRACTIONS ± 1/64 ANGLES ± 1/2° ECCENT'Y .004 T.I.R. GAGE CIRCLED DIMENSIONS	ABOVE DIMENSIONS APPLY BEFORE PLATING. IF PLATED, COATING SHALL BE .0003 ±.0001 ON EACH SURFACE. .010 R. ALLOWABLE AT COR'S AND INSIDE OF SLOTS. BREAK SHARP EDGES.	TITLE STRIKE CIRCULAR, ADJUSTABLE		
CHKD. BY	APPR. BY			PRINT DATE	DWG. NO. A201-609	

SCHLAGE LOCK COMPANY

RS-1633

INSTRUCTOR'S NOTE

Development of a Circular Strike Plate at Schlage Lock Company

This case emphasizes the quality of engineering which can and must be applied to seemingly very simple familiar objects. Grandiose exotic projects are very useful in stimulating students' enthusiasm and imagination, but they need an antidote to arrive at a reasonably undistorted view of engineering. This case provides such an antidote. Mr. Schlage's remarks quoted at the end of part D summarize the technical and human content of the case.

Each part of the case suggests various questions and exercises. We mention a few:

Part A:

A-1 Discuss the economic and engineering implications of prehung doors and prefabricated building construction as contrasted to the traditional on-site construction. *An exercise in engineering economic thinking suitable for class discussion.*

A-2 Give several examples of industries which are based on or which were revolutionized by inventions and name the inventions. *This exercise is intended to put engineering in perspective.*

A-3 Define the terms: mortise lock, cylindrical lock, spring latch, deadlatch, dead bolt, strike plate, doorjamb and doorstop. *Required for understanding of the case.*

A-4 Discuss the subject of patents, particularly their advantages, term in years, infringement, searches, drawings, specifications, claims, elements and cited references.

A-5 Discuss the advisability of an engineer entering his thoughts, ideas, designs and inventions in a notebook. *The extension to student projects is obvious.*

A-6 Invent six methods of latching doors which avoid the need of strike plates. These methods need not be practical, but should be feasible. *An exercise in invention. The latches of garden gates, automobile doors, suitcases, etc., can be used to provide starting points. Sketching or describing the inventions is a good exercise in communication.*

A-7 Sketch six strikes which meet the criteria set up by Mr. Schlage. Pick the most promising two of the six. *An exercise in invention and communication similar to A-1, but less freewheeling. The differences between some of the six methods are probably going to consist of details.*

A-8 Estimate the rebound force on the strike. Explain your method of estimation. *This requires fairly sophisticated reasoning, based on knowledge of dynamics, elasticity, and properties of materials. The estimate can be checked roughly by the knowledge that strikes and doors do withstand the rebound forces.*

Part B:

B-1 Sketch and dimension the punch for the strike A501-883 shown in Exhibit B-4. *A fairly straightforward exercise in mechanical drawing. Note that the 0.168 diameter screw hole and 82 degree countersink will require a separate tool, which could be the subject of a separate exercise.*

B-2 What are the forces applied to the door by the kick test shown in Exhibit B-2? *An exercise in applied mechanics. The forces depend mainly on the stiffness of the point at which the impacter leans on the door. This must be estimated.*

B-3 Propose a test to determine wear of strike plates. How many cycles do you think they should withstand? What shall determine "failure". *This is a wide-open design problem.*

B-4 What further improvements should be made on the strike plate? How would you accomplish them? *This is the main question of the case. It can be asked only if the students have not yet seen parts C or D.*

B-5 Propose standards, equipment and procedures for testing a door lock to determine its resistance to corrosion, or to kicking pulling, twisting, wearing, drilling, prying, hammering, picking the cylinder or shimming the latch bolt. *Each of these questions is a good exercise in itself.*

B-6 What are the advantages of producing a pilot run of a product prior to tooling up for mass production? *Note that the pilot run almost always brings out points which were overlooked during the design of the product or of the tooling. Hardly ever is foresight equal to hindsight. The pilot run is one method of attaining hindsight quickly and at relatively small expense.*

Part C:

C-1 Specify desirable properties for materials for the adjustable strike plates shown in Exhibits C-3 and C-4. Select real materials which meet these requirements as closely as possible. *A combination of ductility and rigidity is desired. Use of*

heat to increase ductility might be considered. Cost is a major consideration. The question emphasizes the need for balancing conflicting requirements.

C-2 Sketch several other adjustable strike plates. *Another exercise in invention and communication.*

C-3 Discuss the following activities of an engineering department: inventing, designing, modeling, testing and costing. *Class discussion will lead to the consideration of career choices by engineering functions rather than by fields.*

C-4 What factors should be considered before substituting plastic for metal? *Modulus of elasticity, creep, and electric conductivity have at times been overlooked.*

C-5 When considering a new product for manufacture, how does the engineering department's viewpoint differ from that of other departments in the organization? *Another wide open question for class discussion.*

Part D:

D-1 The case refers several times to "higher quality appearance"; explain how one of the designs "appears" to be of higher quality. State whether this appearance corresponds to a functional advantage or not. If yes, how?

D-2 Does the design shown in Exhibit D-4 meet the specifications listed at the end of part C? Explain.

D-3 Make a time table of the whole circular strike project. Indicate where the "delays" and "duplication of effort" mentioned on page 3 are in the time table. *Try a PERT chart.*

D-4 Sketch the T-strike with adjustable slide mentioned in the last paragraph.

D-5 Make a fully dimensioned drawing of the T-strike with adjustable slide.

D-6 Compare the design considerations involved in a small, apparently simple, mass production item like the Schlage strike plate with those involved in the design of one spacecraft.

D-7 If you had been assigned the design of an improved strike plate, how would you have proceeded with the benefit of the hindsight you now have? Consider both the technical and the human aspects of the problem.

D-8 Discuss each of the following terms and their relevance to the design and introduction of a product: interchangeable manufacturing, dimensions, tolerances, clearances, drafting, drawing, changes, competitors' patents, owned patents, aesthetics, committee meetings, communications, customers, competitors, salesmen and top management.